KNOWLEDGE
AN ILLUSTRATED MAGAZINE OF SCIENCE, LITERATURE & ART.
Founded by RICHARD A. PROCTOR.

LONDON: APRIL 1, 1899.

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ON THE TREATMENT AND UTILIZATION OF ANTHROPOLOGICAL DATA.

By Arthur Thomson, M.A., M.B.

II.—THE HAIR.

In a previous article we dealt with the question of colour. We propose in the present chapter to take up the consideration of hair. It is a matter of difficulty to explain how man came to lose the covering of body hair with which he seems at one time to have been clothed. Most of us fail to recognize the fact that, covering almost the entire surface of the face and body, there is a scanty "down," so slightly developed, however, that it escapes our notice unless our attention be particularly directed to it. Yet it is remarkable that this hairy covering is better seen, and more uniformly distributed over the surface of our bodies at the time of our birth than in after years. The significance of this "lanugo," as it is called, is important, as it serves to indicate that during his development man passes through a stage in which his hairy covering is relatively better developed than at a later period of his growth. After birth we find that the hair covering the scalp continues to grow, whilst that covering the body undergoes regressive changes, and is represented in the adult by the "down" above referred to, the survival doubtless of a state in which our bodies were better protected in this respect. Much may be learned from a study of this fœtal hair. The manner in which the hair is implanted in the skin serves to indicate the habitual position in which the part so covered is exposed. To render this clear, it may be necessary to remind the reader that hair is a protective covering, which shields the animal from the inclemency of the weather, acting in some respects like thatch to carry off moisture falling on the surface of the body. We find, therefore, that in the more exposed situations the hair is directed downwards. Now, by a comparison of the manner in which the hair is implanted in man as contrasted with animals, we may obtain some hints as to differences in the habitual posture of the body and the disposition of the limbs.

What, perhaps, strikes us as most remarkable, is that in man the body hair is more scantily developed over the back of the body than over the front of the trunk. We see this particularly in those who, in adult life, develop a strong growth of body hair. The anterior surface of the trunk, thigh, and legs is usually covered with a stronger growth than the posterior surface of these same regions. Now this is in striking contrast with what we see in mammals as a rule; in them the growth of fur over the under surface of the trunk and the inner sides of the limbs is much more sparse than over the more exposed surfaces of the back and the outer aspects of the limbs. From this we may infer that man retained his hairy covering for some time after he assumed the erect posture, and that that growth was thickest over the most exposed surface of the body. We might, perhaps, explain our meaning better by saying that his weather side (*i.e.*, the front of his body) had a better covering to protect it than his lee side (*i.e.*, his back), in contradistinction to what maintains in quadrupedal mammals, where the dorsal surface of the trunk is more exposed to the inclemency of the weather. We will not here concern ourselves with those remarkable growths of body hair which appear after the age of puberty other than to observe that we know of no comparable growth in mammals—indeed the contrary seems the more general rule for those regions, *i.e.*, the axillæ and pubis, which in man are the most thickly coated are in lower forms the most thinly covered. At the same time we may add that the theory advanced by Dr. Louis Robinson—viz., that the axillary tufts were useful as affording the offspring a means whereby to get a good grip when, during flight, they sought the protection of the parent—appears to us more ingenious than convincing.

Before leaving the question of the general distribution of hair over the surface of the body, it may be of interest to note that, exceptionally, remarkable instances are met with of a pronounced development of this body hair. The most striking example hitherto met with is that of a family in Burmah, the members of which all displayed to an unusual extent this exceptional growth of hair. Doubtless many of our readers may remember the exhibition of some members of this family, and the photographs of them may still be obtained by those who seek for the curious. Among the races of man, the Ainu, who inhabit the islands north of Japan, are accredited with a stronger growth of head, face, and body hair than usually falls to the lot of most. In consequence these people are often spoken of as the hairy Ainus, though it may be candidly admitted that they are credited with a hairiness which facts do not seem to justify.

Whilst the foregoing considerations are interesting in

view of man's descent, what more immediately concerns us are the variations met with in the texture and appearance of his head hair, for advantage is taken of these differences to help to classify the various races of man. We have already referred to the importance of hair as an index of colour, and we took occasion in a previous article to point out that, under ordinary conditions, there was a limit to its use in this respect, for what appeared to us as black hair might contain a much less amount of pigment than another sample, which appeared no blacker, if one may use such an expression. We then stated that the only satisfactory way of estimating the "blackness" of the hair was to extract the pigment from samples of equal weight.

But apart altogether from the question of pigment, we have the texture of the hair to consider. We are all familiar with what we term coarse and fine hair. Coarseness here implies that the individual hair is thick as compared with the fine variety. This thickness imparts to the hair a wiriness, which causes it in bulk to be less amenable to the use of the brush and comb than the thin or sleek variety. Furthermore, a thick hair may contain proportionately less pigment than a fine hair, weight for weight; the pigment is, as it were, present in more dilute form, so that the colour is not so pronounced, an explanation why the hair of the beard and moustache usually appears lighter in tint than the finer head hair. Again, some hair is straight, some wavy, and some curly. We find, as a rule, that thick hair is the straightest, whilst the finest hair is that which constitutes the "woolly" hair of the negro and negrito. Wavy hair is usually a hair of intermediate thickness. But hitherto we have assumed that all hair is of the same shape, that is, cylindrical on section. This we shall find presently is not the case. It is now many years since Pruner Bey drew attention to this difference in the hair of man. By making sections of different head hairs, he demonstrated that every variety between that displaying a circular form on section and that showing an oval or flattened section was met with. The

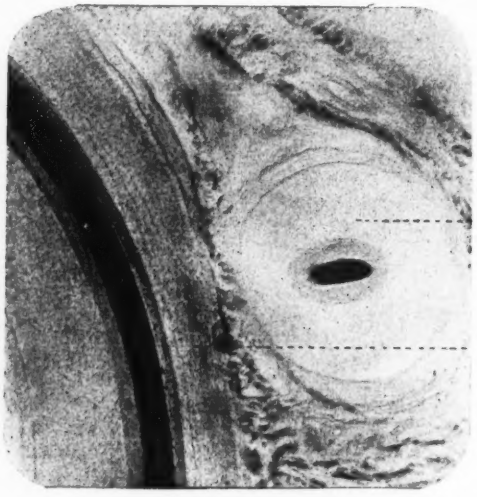


Fig. 1.—Section through scalp of a Bushman, showing curved hair follicles cut transversely (*a*), and longitudinally (*b*). In the centre of the hair follicle *a*, the flattened form of the section of the hair is seen.

circular section is characteristic of straight hair, either fine or coarse; the flattened form of curly or "woolly" hair; whilst the wavy variety displays intermediate forms. At that time this difference in the form of the hair was considered a sufficient explanation of its straightness, curliness or waviness, and it was not till some years later that Prof. Charles Stewart, of the Royal College of Surgeons Museum, pointed out that not only was the hair of the negro curly, but the follicle within which it grew was also curved (Fig. 1). This naturally leads us to a consideration of the structure of a hair follicle.

In a previous article,* some account was given of the structure of the skin, which consists of the dermis, or true skin, and the epidermis, scarf skin, or cuticle, which overlies it; the latter is further sub-divided into two strata, a superficial horny layer, and a deeper juicy layer, the *rete mucosum*; between these there is an intermediate folium, comprising the *stratum granulosum* and *stratum lucidum*. If the reader can conceive these superficial layers as pushed downwards around some solid cylinder into the substance of the true skin, or even onward, into the subjacent tissue, he will be able to form some idea of the manner in which the sheath of the hair is formed. The bottom of the recess so produced has projected into it from the vascular dermis or true skin a papilla-like growth. Around this the layers of the in-

Fig. 2.—Photomicrograph of section through hair follicle. The root of the hair is displaced so as to show more distinctly the dermic covering and papilla, and the epidermic sheathes. *a*, Hair shaft; *b*, epidermic lining of sheath; *c*, dermic sheath of follicle; *d* marks the point where the eversion of the epidermic layers takes place over the surface of the papilla; *e*, papilla of the dermic sheath; *f*, subcutaneous tissue.

vaginated sheath are reflected, and as at this point, owing to its greater vascularity, the cell growth is most active, it follows that the cells of the *mucosum* which are proliferating most freely are thrown on to the surface of the papilla, and having no room to accumulate within the sheath, are gradually pushed along it so as to appear ultimately at its orifice on the surface of the body. Now, the evagination of the layers at the bottom of the sheath, dependent on the presence of the papilla, naturally leads to the eversion of the horny layer as well, so that we have a hair formed, the outer cells of which are horny, whilst the inner are soft, and form the core or medulla. The softer cells of the *mucosum*, as they advance over the surface of the papilla, naturally absorb the pigment which is brought to them by the blood and lymph streams, but as they advance

* Knowledge, February, p. 25.

they retain their pigment, and thus cause the hair to be coloured. In this respect these lower cells of the *mucosum* differ in their behaviour from what we have seen in the

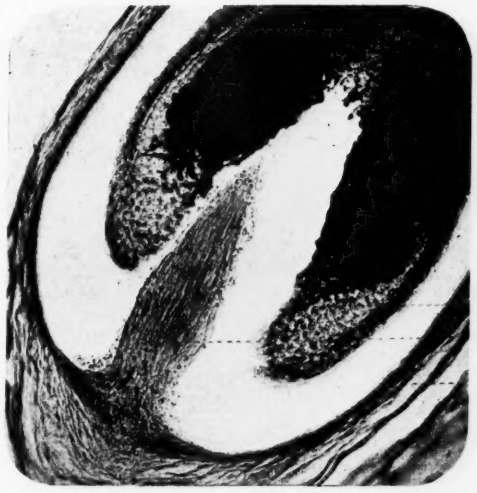


Fig. 3.—The same as Fig. 2, more highly magnified. *a*, The deeper cells of the epidermic layers, loaded with pigment; *b*, shows where the epidermic layers are everted over the surface of the papilla; *c*, the papilla, an upgrowth from the dermic sheath; *d*, the dermic sheath.

integument, for there they remain pigmented only in the deeper layers. As was stated in the previous article, if we adopt the accepted view with regard to the regeneration of the more superficial cells of the epidermis, we have to account for the disappearance of the pigment within these cells of the *mucosum* as they advance to the surface, but as was pointed out in the same article, the accepted view appears to us untenable, and necessitates the explanation of the disappearance of the pigment in the superficial layer of cells, which disappearance curiously does not occur in the hair, although it is probably subjected to similar influences. The view we suggested, viz., that the intermediate layers of the epidermis, *i.e.*, the *stratum granulosum* and *stratum corneum*, were the active layers, and that growth occurred in two directions, *i.e.*, towards the surface and towards the true skin, would at once overcome all difficulties—difficulties which are still further emphasized when we come to deal with the coloured races. If the reader has followed the description given above, he will recognize that the evagination of the layers of the sheath over the papilla at the base of the follicle leads to an eversion of these layers, so that the deep layers of the *mucosum*, no longer imprisoned by contact with the superficial aspect of the *cutis vera*, are now thrown outwards over the surface of the papilla and pushed onward into the sheath. So long as there is pigment to absorb these cells will retain it; but as the deeper layers of the *mucosum*, which rest on the surface of the *cutis vera*, cannot be displaced, the pigment remains there permanently; whereas over the surface of the papilla, the cells, constantly shifting, carry with them the pigment, they have absorbed, into the body of the hair; when, however, that supply of pigment ceases, there is no longer any for the moving cells to absorb, the consequence being that the cells forming the hair are now colourless, and so the hair appears on the surface as grey at the root. In this way we have a simple explanation why a negro may have grey hair and yet retain the blackness of his skin; in the former situation the pigment-loaded cells are shed, and

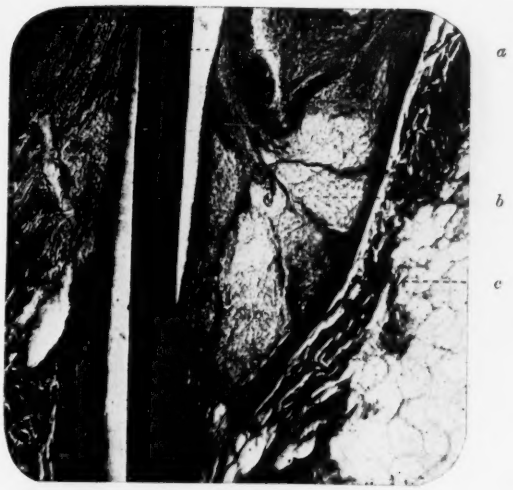
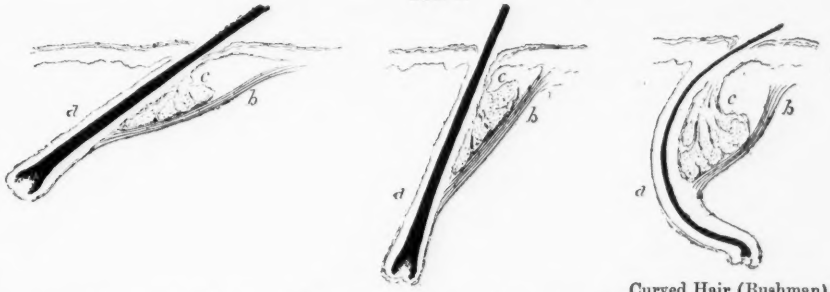


Fig. 4.—Longitudinal section through hair follicle, showing sebaceous gland and hair muscle. *a*, Hair shaft; *b*, sebaceous gland; *c*, muscle of hair.

cease to be coloured when there is no more pigment to be absorbed; in the latter situation the cells constitute a permanent layer, which never advances to the surface, and therefore retain for indefinite periods the pigment which has been taken up.

The question of the manner of production of the straight and curly varieties of the hair has long been a matter of conjecture, and hitherto no satisfactory explanation has been forthcoming. There are a number of facts which it appears to us are of importance in the consideration of this question. Each hair follicle is provided with a sebaceous gland opening into it, together with a muscle connected with it; these are well represented in the photomicrograph (Fig. 4). The size of the gland

Fig. 5.



Straight Hair. *a*, Hair follicle, with hair shaft inside; *b*, hair muscle; *c*, sebaceous gland.

Straight Hair erected by action of Muscle. *a*, Hair follicle, with hair inside; *b*, hair muscle; *c*, sebaceous gland.

Curved Hair (Bushman). *a*, Curved follicle, with hair inside; *b*, hair muscle; *c*, sebaceous glands.

varies considerably in different individuals, and from our own observations appears larger and better developed in the negro races. The muscle called the *erector pili*, from its attachments, has long been recognized as having an influence on the position of the hair, causing its erection by pulling forward the root of the hair, thus converting the shaft into a lever, the fulcrum of which corresponds to the dense *stratum corneum* through which it passes to appear on the surface. Such action of these little muscles is displayed when a cat in rage erects the hair of its tail, or a straight-haired dog causes the hair of its back to rise in a median crest (Fig. 5). Their influence in man is commonly observed in the condition known as "goose skin." Further, it is to be noticed that the gland is always placed between the muscle and the hair shaft, thus occupying the triangular interval between them, so that during the action of the muscle the gland must necessarily be subjected to pressure, aiding thereby the expulsion of its contents.

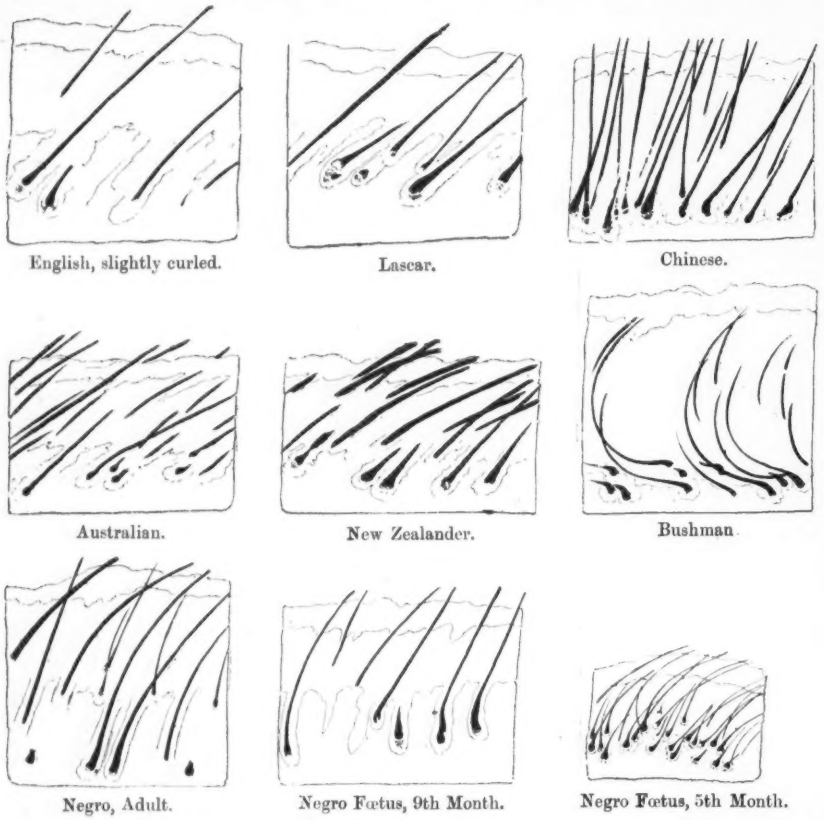


Fig. 6.—Sections showing appearance of the hair follicles in the scalps of races with straight, wavy, and curly hair.

As has been already stated, straight hair is always circular in section, and is usually thicker than curly hair, which is ribbon-like and fine, the finest human hair being that met with in the Bush and Andaman races. Now it appears to us that these facts have a most important bearing on the question under consideration. In order that the muscle afore-mentioned may act as an erector of the hair, it is necessary that the hair must be sufficiently strong to resist the tendency to bend; unless this be so, the lever action is at once destroyed. On the other hand, when the hair is fine and ribbon-like, the shaft, no longer sufficiently stout to resist the strain of the muscle, naturally assumes a curve, and this, we think, is the explanation why the follicle assumes the form so well displayed in the section of Bush scalp represented in Figs. 1 and 6. The influence of the sebaceous gland on this curvature must not be overlooked. If a scalp, in which the follicles are curved, be examined, the gland is seen to be placed on the concave surface of the curve, and the muscle is attached to the same side of the follicle just below the gland; the gland, therefore, forms a mass of greater resistance around which the follicle may be curved by the traction of the muscle, thus leading to the characteristic form of the follicle met with in races with curly hair. At the same time it may be noticed that the base of the follicle is often hooked backwards, as may be seen in the Bush scalp (Fig. 6), and this, presumably, must be accounted for by its vascular connections, which are here best developed, and which will tend to withstand the strain exercised by the muscle. The follicle thus becoming more or less permanently curved, it naturally follows that the softer cells at the root of the hair will accommodate themselves to the curve, and becoming more horny in their consistence as they advance to the surface, will retain the form of the follicle in which they are moulded, the cells on the concave side of the hair being more compressed than those on the convex side. In this way we have, in all probability, a more reasonable explanation of how curliness in the hair is produced than any hitherto offered.

There are other considerations which might be mentioned in this connection, but these are beyond the scope of the present article.

THE LOVE-GIFTS OF BIRDS.

By Charles A. Witchell.

APRIL and May are the chief months in which wild birds are nesting; and in these months the birds' small property is most heavily taxed by collectors. All but a minute fraction of this waste of egg-life is useless. But this is an old theme. The remark might be permitted, however, that in the treatment of wild birds the country should learn from the city, where public ornithology rises above the use of the gun, and knows how to tame as well as how to kill. It might be of benefit to the sportsman who goes to the seaside armed with a gun if he were to stand for five minutes on the Embankment, or on the bridge in Regent's Park, to see the gulls fed.

In some earlier articles in Knowledge I have endeavoured to prove to the person who is developing an interest in

bird-life (with the usual results), that if he does but sit down under a hedge instead of searching it, and looks and listens, he may gather a richer store than ever filled a collecting-box, though it be but a store of changing pictures in memory's cinematograph.

It is now proposed to approach another theme—the restraint of a wild bird's impetuous voracity when it offers food to a courted companion or a brooding mate. The incident proves the bird to be akin to man in sense and feeling; and even the possession of ulna, radius, and metacarpals, will never prove that. It is not every animal that rises to so high a level as to share dinner with a mate; not all dogs, nor even all human beings attain to it.

Of course, if adult birds of any species habitually fed each other on ordinary occasions, the same behaviour in the breeding season would be no evidence that it had anything to do with love. But the converse is the case. I have never heard of a wild bird which habitually shares its food with a mate. In times of scarcity, however, a bird has sometimes been observed to feed a companion. In the severe winter of 1879-80 there was a good deal of snow in the western counties, and the rooks had a bad time, finding a diet of mangold insufficient. Several of them came to a garden in which the birds were fed. Another rook, whose flight betrayed its lightness and weakness, perched in a tree there, and one of the usual two or three took up a piece of bread directly to the newcomer, and gave it up to him without any show of resistance or anger. I saw this from a distance of about twenty-five yards. Quite possibly the birds were mates; but the incident is only mentioned for its rarity.

In the nesting season the males of many species feed their mates on or "off" the nest, as is well known. The rook, for instance, brings food to his mate, who, when receiving it, flutters her wings (a frequent habit at this time), and also utters a hoarse cry similar to the cries of the young. The adult rook utters this note on no other occasion. In several species of finches, also, the male feeds his sitting mate. I have seen this done by the chaffinch, greenfinch, linnet, and lesser redpole. The recipients shook their wings and uttered call-notes. The food thus bestowed could hardly be termed a "love-gift"; but when, before birds have a nest, and apparently before they have paired, the male gives the female morsels of food, it is fair to assume that this courtesy is intended as an earnest of passion—that it is, in fact, a love-gift.

I do not know of any book to which the student can refer for information on this fascinating theme. He should, therefore, refer to the book of nature; and if he will use a small telescope, and be silent, he should easily obtain information from this source.

Among the raptores, it is probable that the brooding female obtains food chiefly by the agency of her mate. Major C. Hawkins Fisher (the well-known falconer) informs me that the male peregrine hunts all day to supply the domestic larder, which is in the charge of his mate.

Among domestic birds, the common fowl affords a conspicuous instance of gallantry when the male calls the females to some choice morsel. He obviously intends the tid-bit only for the hens, and any rival attempting to partake of it is at once attacked.

In regard to domestic pigeons, I have obtained information from my brother, Mr. E. N. Witchell, who has been for many years a successful flier of homing pigeons, and has from childhood kept this and other varieties. One of the indications of pairing by pigeons is the insertion of the beak of the male into that of the female, and this is accompanied by a shuffling of the wings exactly as occurs when the young are fed. It does not appear, however, that any considerable amount of food (if any at all) passes from the male. Homers never omit this performance before pairing. The male homer is passionately fond of his home, his mate, and his young. But though his mate is a model wife, he is not a model husband, and often, especially if a strong flier, he is likely to bring domestic troubles into the life of any unmated young female bird in the loft. But it is a general rule for the cock to "feed" only his own hen, though there are exceptions to this rule. This very curious fact has often been noticed by my brother. It indicates that to the wife of the nest this courtesy of the pigeon is reserved, and that the other birds are deemed unworthy of it. These observations do not apply to pouters, runts, and trumpeters, which are "very immoral." It should be remembered that homers live the most naturally of any except farmhouse pigeons, and they may, therefore, be supposed to possess the natural instincts of their race in greater vigour than any other fancy breed.

Returning to wild birds, my opportunities have been too limited to enable me to generalize; but the following observations may be not without value to those who try to see in the bird a sentient and tender being.

A few days after the arrival of the spotted flycatcher, a pair of them were in a near tree. The male often attempted a song, and was evidently following the female. He suddenly went forth on a longer journey than usual, as though for a larger insect, turned and went to the female, and in the gentlest manner presented to her the captured insect (which appeared to be of the size of a bee). She took it sedately. Shortly after, she received another gift of the same kind. A second pair of flycatchers behaved in precisely the same manner. Last April a male robin gave some food in the same way to its mate. Both birds often uttered their call note.

Several male chaffinches, before nesting time, gave captured insects to their intended mates. All these insects were captured in flight. The chaffinches were full of ardour, the males, all a-flutter with excitement, following the females, and with the cuckoo-like flight, which is one of the bird's surest signs of love, and repeating the soft love-note almost incessantly.

On one of the first days of May, two willow wrens were busy in a hedge. The male often sang, but was mainly intent on keeping near his companion, who appeared to be a female bird. She was seemingly indifferent to his presence, and hunted for insects with all the graceful activity of her species. But she remained in the same spot. The male was greatly excited, his wings lowered and pulsating, and his call-note prolonged to a scream rather than a chirp. Through the telescope it was evident that she also was trembling a little. Suddenly the male darted forth, returned and alighted near the other. He then without haste went to her, and her beak met his. The incident was so brief that the telescope could not be used; but it was, perhaps, fair to assume that he had found and bestowed a love-gift. She accepted it with the same sedateness that the female flycatchers, chaffinches, and robin had exhibited in the like circumstances.

THE ACETYLENE INDUSTRY.

By George T. Holloway, assoc. R. coll. Sc., F.I.C.

ACETYLENE or "ethine" has been known for about sixty years, yet it is only within the last four years that it has been proved possible to produce it at a cost which renders it of commercial importance. Even now, it must be considered to be merely on trial, although the industry which embraces

the manufacture of calcium carbide, and the production from it of acetylene, is already an important one, and is represented by over half-a-dozen journals in various languages specially devoted to its interests. This gas has always occupied a peculiar position among organic bodies, from the fact that it is the lowest member of the important group of compounds known as hydrocarbons; and, further, that it is the only hydrocarbon which can be produced synthetically, and that it thus forms the starting point from which other organic bodies have been built up. Its singular properties and the manner of its decomposition, under certain conditions, have also contributed to placing it in a unique position.

Acetylene was first prepared in an impure state by Edmund Davy, by the action of water on the mass obtained by heating cream of tartar in an attempt to manufacture metallic potassium. He called it "klumene," but, as he made no investigation of its properties, it attracted no interest until its re-discovery by Berthelot, who obtained it in a state of purity. It may be prepared synthetically by the action of hydrogen on carbon heated to whiteness by the electric arc. It is also produced by strongly heating or sparking marsh gas—many other bodies, including benzene, being also produced; or by the incomplete combustion of hydrocarbons, such as those in coal gas, as is noticed when a Bunsen burner "burns back."

These processes, however, are of scientific interest only, as the amount of gas produced is but small in any case, and the method of production which has given rise to the acetylene "boom" consists in the action of calcium carbide upon water. The carbide is now always produced electrically, as described later on.

Acetylene is a colourless gas about nine-tenths the weight of air. It is stated to have a pleasant ethereal odour when pure, but, as ordinarily prepared, it has a strong unpleasant smell resembling that noticed when ordinary iron filings are dissolved in dilute hydrochloric or sulphuric acid.

At eighteen degrees Centigrade it can be liquefied by a pressure of eighty-three atmospheres, while at one degree Centigrade only a pressure of forty-eight atmospheres is required. It forms a mobile liquid, having a specific gravity of 0·451 at zero Centigrade, and it has the lowest refrangibility of any known liquid or solid, also the greatest co-efficient of expansion. At eighteen degrees Centigrade, water dissolves its own volume of acetylene gas, carbon tetrachloride or turpentine dissolves twice its volume, amyl alcohol three and a-half, benzene four, and glacial acetic acid six times its volume, while acetone, which has been proposed as a convenient means of storing the gas in solution, dissolves no less than twenty-five volumes at fifteen degrees Centigrade, at the ordinary pressure, and three hundred volumes at twelve atmospheres pressure, but the solubility is much less at higher temperatures, and is only half as much at fifty degrees Centigrade. Commercial acetylene is poisonous, though not so injurious as carbon monoxide. The gas affects the respiration and weakens the heart and lungs. The pure gas is said to be harmless when inhaled in small quantities, and Dr. Weyle states that air containing nine per cent. of ordinary acetylene may be breathed for a "long period" without serious results.

Among its other peculiarities, acetylene has the power of combining with many metals with the production of highly characteristic compounds, which are of importance as bearing upon the dangers attending its use, and also as affording a convenient means of purifying it or of ascertaining its presence in admixture with other gases. The most interesting of these compounds is the acetylide of copper, which is formed as a red precipitate when acetylene is passed through an ammoniacal solution of cuprous chloride. When dry, it explodes if struck or if heated to one hundred to one hundred and twenty degrees Centigrade, leaving a black velvety mass containing carbon and metallic copper. This acetylide is so characteristic that its production forms the most delicate test for acetylene, as little as 0·005 of a milligramme being thus capable of detection according to Berthelot. The well-known danger of explosion, often from unascertained causes, may be largely attributed to the fact that acetylene is an endothermic compound—*i.e.*, that the combination of carbon with hydrogen to produce acetylene absorbs heat to the extent of sixty-one thousand one hundred heat units. Hence, any cause which gives rise to a sudden decomposition of acetylene results in the evolution of great heat. The decomposition of the gas by the induction spark at the ordinary atmospheric pressure is not, however, rapid, and takes place only where the spark acts. Liquid acetylene appears to explode *en masse* under certain conditions, and, as these are not clearly defined, it must be regarded as highly dangerous. The explosions which have occurred were so destructive as to prevent the possibility of determining the cause.

Messrs. Berthelot and Vielle find that, under a pressure of two atmospheres or more, even a platinum wire heated by the electric current produces complete and explosive decomposition of acetylene gas. The intensity of the explosion increases with the initial pressure, and this increase is very rapid as the pressure approaches the liquefying point of the gas. Liquid acetylene may be similarly exploded by a hot wire, but not by blows or shocks, although the breakage of a cylinder of the liquid by a blow is usually followed by an explosion, probably induced by sparks from the friction of the broken metal. These investigators are, however, of opinion that the properties referred to need not prevent the domestic use of acetylene if proper care is taken in the preparation and manipulation of the gas, and it appears evident that the purer the acetylene is the less danger exists of explosion from friction and other causes.

According to Prof. Clowes, air containing any proportion of acetylene between three and eighty-two per cent. is explosive, and, as this is a far wider range than is shown by any other combustible gas, there is little doubt that it is in part due to the endothermic nature of acetylene. It is stated by Gréhau that the most explosive mixture contains one volume of acetylene to nine volumes of air.

Before considering the manufacture of calcium carbide and acetylene on a large scale, it is of interest to note that although many other metallic carbides exist, that of calcium is at present the only one known which yields acetylene in sufficient quantities to stand any chance of competing with coal gas, electricity, etc., as a source of illuminating power. In the case of aluminium carbide, for instance, the action of water yields practically pure methane (marsh gas), while the carbide of manganese, under similar conditions, yields methane and hydrogen, and that of uranium gives off not only gaseous but also liquid and solid products, mainly of the ethylene group.

The best calcium carbide in the market is that produced by the Acetylene Illuminating Company at Foyers, in Scotland, but the Willson Company at Spray and Niagara Falls, in America, the Neuhausen Aluminium Company, in Switzerland, and many other companies, are also large producers. The principle of manufacture is the same in all cases, and consists in passing a powerful electric current, by means of large carbon electrodes, through a mixture of carbon and lime. The best form of

carbon has been found to be coke, and unslaked lime is preferred to slaked lime.

The following account refers to the method of production employed at the Willson Aluminium Company's Works. The coke, containing from seven to ten per cent. of ash, is pulverised and mixed with ground lime, containing about one and-a-half per cent. of magnesia, and not more than one per cent. of other impurities, sixty-four to sixty-five parts of coke to one hundred parts of lime being used. The mixture is charged into an iron car, the bottom of which is covered with a layer of carbon, which forms one of the electrodes, and is connected with the dynamo conductor by a clamp, fixed to a projection on the car by a screw.

The other electrode consists of twelve carbon pencils, each four inches square and thirty-six inches long, dovetailing into a holder, and surrounded by an iron jacket to minimise waste by oxidation. This electrode is connected with the dynamo by a copper bar enclosed by iron slabs, and its height is adjusted by means of a chain operated by a screw, as the current is found to vary from the amount required.

The charge is run into the car through shoots, aided by four-bladed feed rods. The car is automatically moved to and fro about two inches, twenty times a minute, by means of a rod, to keep the mass compact. The gases evolved during the reaction escape at a chimney, and a cold-air jacket is also provided. Doors are fitted to the furnace. The charge covers the pencils to a height of about twelve inches.

The best yield has been found to be produced by a one hundred volt current and one thousand seven hundred to two thousand ampères. The carbide is obtained in the form of an ingot, the inner portion of which is almost pure. Around it is a less pure carbide, containing fifty to seventy per cent. of carbide, while this, again, is surrounded by the unaffected charge which is used again. The pure and second rate carbide are usually broken up together so as to yield a mixture which gives five cubic feet of acetylene per pound of carbide, instead of 5·89, the theoretical amount under ordinary atmospheric conditions.

At the extensive Swiss works, where the cheap water power has given rise to the erection of several large carbide plants, the method of production is somewhat different, the reduction being performed in crucibles and the product usually drawn off while liquid. The selling price of the Swiss carbide is now about forty centimes per kilogramme (2·2 lb.), say £16 per ton, for quantities of over a ton. According to Korda, the cost of production at present never falls below £10 per ton.

SECRETS OF THE EARTH'S CRUST.

By Grenville A. J. Cole, m.r.i.a., f.g.s., *Professor of Geology in the Royal College of Science for Ireland.*

II.—THE OLDEST FAUNA OF THE GLOBE.

PRIOR to the publication of Darwin's "Origin of Species," most geologists would have been content to regard the oldest known fossil fauna as truly that which was first formed upon the globe. The Cambrian strata, investigated by Prof. Sedgwick about 1840, were seen to contain a considerable number of organic remains; but these were obviously more obscure and "primordial" in type than those found, in such wealth of variety, in the overlying Silurian beds of Murchison. Even when, in 1846, Barrande had revealed the beauty of preservation of the Cambrian fossils of Bohemia, the absence of any evidence of previous organisms made it natural to suppose that life itself sprang into existence at this horizon. The arguments that were fully justified only sixty years ago are well expressed in the words of Mr. Joshua Trimmer :—*

"The rocks of the Cambrian group . . . . occur at but few points, and in small quantities, amidst a great thickness of sedimentary rocks, extending over a wide area, and this circumstance, connected with the paucity of species where the fossils are in the greatest abundance, appears favourable to the presumption that the absence of organic remains from the older stratified rocks of the mica slate and gneiss systems is not the effect of any process by which they have been destroyed, and that in the Cambrian rocks we behold the first appearance of organic life upon the surface of our planet."

Prof. John Phillips, in devising the terms Palæozoic, Mesozoic, and Cainozoic, recognised that we must divide up geological time by the succession of faunas, as established by William Smith in 1815. The base of the Palæozoic or "old life" group has long been fixed at the bottom of the Cambrian system. Any strata earlier than that horizon became styled Azoic (devoid of life) or Eozoic (dawn of life), according to the philosophy of the writer. Nowadays, the terms Archæan and Precambrian, which commit us to no opinion, are employed for this most ancient group. It is obvious that one of the profoundest secrets of the earth's crust has been entrusted to the Precambrian strata.

Mr. Trimmer, as above quoted, and his contemporaries, commented on the absence of organic remains from the "mica slate and gneiss systems," the fundamental rocks on which so many of our Cambrian beds repose. Even if these old rocks result from the metamorphism of sedimentary masses, it is extremely improbable that fossils could remain in them unharmed. In recent years, moreover, it has been made clear that the banded structures of schist and gneiss, so long relied on as indications of a sedimentary origin, are commonly due to flow of the mass, or, in some cases, to the penetration of one rock by another in thin parallel sheets. Scrope and Darwin† long ago ascribed these foliated structures to flow in a non-homogeneous body; but the truth of their observations was overlooked for half a century. The result, however, of the acceptance of their views is that few are likely to look for fossils on the foliation-planes of an Archæan schist. It chances that here and there, among Palæozoic schists, some remains of organisms have survived; but their broken and distorted condition offers little hope to the student of more fundamental masses.

In many parts of the globe, however, we find unmetamorphosed and clearly stratified rocks, underlying the lowest Cambrian, and resting unconformably on the ancient metamorphic series. Thus the normal types of sediment by no means begin with the fauna studied by Sedgwick and Barrande. It has become, indeed, necessary to set a limit to the Cambrian deposits, a limit which shall at the same time mark the close of the mysterious Archæan era.

Such a limit has been found in what is called the *Olenellus* zone, or, better, the *Olenellus* series. Just as it is convenient to classify the Cretaceous beds by their prevalent sea-urchins, or the Jurassic beds by their ammonites, or the Ordovician and Silurian by those obscure

* "Practical Geology and Mineralogy," 1841, p. 199.

† See, for instance, G. P. Scrope, "Geology of the Ponza Isles," *Trans. Geol. Soc.*, 1824, p. 228; and Darwin, "Geol. Observations on Volcanic Islands," end of chapter iii., and "Geol. Obs. on S. America," end of chapter vi.

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but useful organisms, the graptolites, so the trilobites have been selected for the division of the Cambrian system. *Olenus*, *Paradoxides*, and *Olenellus*, mark respectively the Upper, Middle, and Lower Cambrian; and the fauna associated with *Olenellus* has naturally assumed considerable importance.

In America, where the first forms of this trilobite were described, the succession of the strata was obscured by the thrusting up of the Lower Cambrian locally upon higher beds, and even on the Ordovician. The fauna was carefully worked out, but its importance was not at first fully realised. Dr. Brogger,* however, compared it with that of the *Olenellus* beds of Europe, which were clearly at the bottom of the series; and he urged that further examination of the succession in America would lead to some re-arrangement of ideas. Mr. Walcott† undertook this work by visiting Newfoundland, where the beds were less disturbed; and in 1888 he triumphantly reported that *Olenellus* and its associates must be placed as the fundamental fauna. Since then the name of this trilobite has become familiar, and the search for organic remains below the *Olenellus* beds has been undertaken in every quarter of the globe.

In our own islands, inroads have been made on the accepted dicta of our text-books. Prof. Lapworth‡ announced, in 1888, the discovery of *Olenellus* near the base of the Comley or Hollybush Sandstone in Shropshire. This same Hollybush Sandstone was formerly regarded as Middle Cambrian. A far more important change is the consequent reference of the Longmynd mass to the Pre-cambrian systems. Though its boundaries are in part faulted and obscure, there is little doubt as to its antiquity, especially as the series following upwards from the *Olenellus* beds are represented by fossiliferous strata in the same locality, quite different in character from the barren slates and sandstones of the Longmynd.

In 1891, Sir A. Geikie§ recorded *Olenellus* from the North-west Highlands of Scotland. The trilobite, and its associated fauna, occur in the base of the Durness series, which was long supposed to be Ordovician. This series reposes unconformably on the famous Torridon Sandstone. The latter thus becomes Precambrian.

Here, then, we have in Britain two fine masses of deposits in which to search for an earlier fauna than the Cambrian. As yet, unfortunately, only obscure traces have been discovered.‖ While ripple-marks and rain-prints show that the conditions of deposition resembled those of modern strata near a shore, the Longmynd beds for many years yielded nothing except worm-borings and worm castings. Imperfect brachiopods (*Lingulæ*) are now recorded by Prof. Blake. The Torridon Sandstone, with its gritty and conglomeratic strata, is even less likely to have retained traces of organisms.

The prize may, however, ultimately fall to some unprofessional but keen-eyed visitor to either of these interesting regions. The Longmynd—the "long mountain"—forms a picturesque highland, rising to seventeen hundred feet, west of Church Stretton in Shropshire. Its moorland slopes, cleft by steep ravines, its heather-clad crests and sparkling streamlets, attract the eye by contrast with the cultivated lands. Grouse still call across these wilder summits; and the geologist, cycling, it may be, from London, finds in the Longmynd his first contact with the mountains.

The Torridon Sandstone offers a far wider field. It forms a sort of bulwark, a chain of fastnesses, on the north-west coast of Scotland, stretching for seventy miles from Loch Carron to beyond Lochinver. The total thickness is estimated at from eight thousand to ten thousand feet; and Sir A. Geikie has pointed to occasional shaly bands as possible preservers of the fauna. The material of the sandstone is derived from the crystalline Archæan masses; and in places, as on the coast of Lewis, the conglomerate between the sandstone and the gneiss provides a fine picture of the ancient shore. But the great secret will hardly be revealed in these sandstone beds themselves. Such rocks are proverbially barren; and shells that may have lain upon a pebbly beach become broken up during entombment, or are dissolved away later by permeating waters. The Torridon beds, moreover, may be lacustrine, like the Old Red Sandstone to the east; this would still further limit their fauna, in comparison with that which may be found in other areas.

In Charnwood Forest, a rough upland rising unexpectedly through the industrial lowlands of Nottingham and Leicester, another Precambrian area has been recognised. But the slates and sandstones, associated with volcanic tuffs, have here given no sign of fossils.

In almost every region of Archæan rocks, whether we select North America, Scandinavia, or Bohemia, we find similar stratified Precambrian systems resting on the highly metamorphosed or igneous series. These systems are not likely to prove of the same geological age throughout the world. If the "fundamental gneisses" represent in any area the primitive crust of our cooling planet, an enormous interval of time must separate the period of their consolidation from that in which *Olenellus* flourished. In the intervening deposits, the succession of which is yet unknown, lies entombed the oldest fauna of the globe. The earlier of these deposits must have been laid down in water of high temperature; but it is just possible that a more uniform distribution of heat, and an absence of the chilly depths that now prevail in our oceans, may have favoured the spread of primordial life across the globe.

Lowly forms of life, in a suitable environment, multiply with extreme rapidity. Their comparative immunity from disease, their simple and easily satisfied needs, the convenient interchange of their protoplasm from one individual to another, give them, indeed, the semblance of immortality. But it is only when such forms became provided with a skeleton or a shell—when, in fact, their needs had grown far more complex—that their remains had a chance of being preserved.

If, further, we hold with Prof. Judd* that "no good reasons have been adduced for asserting that any of the highly crystalline rocks—whether foliated or not—were originally part of the globe as it first consolidated from a state of fusion," we may well despair of finding any fauna of such vast antiquity as that now under discussion. The mutual interpenetration of members of the old gneissic series certainly suggests that much valuable evidence has been altogether swallowed up in cauldrons of re-melted fundamental rocks.

But this fascinating secret is not to be disposed of or set

* "Om alderen af Olenelluszonen," *Geol. För. Stockholm Förhandlingar*, Bt. VIII. (1886), p. 182.

† "Succession of Cambrian faunas in N. America," *Nature*, Vol. XXXVIII., p. 551.

‡ *Geol. Mag.*, 1888, p. 484; *ibid.*, 1891, p. 532.

§ *Geol. Mag.*, 1891, p. 498. See also Peach and Horne, *Quart. Journ. Geol. Soc.*, Vol. XLVIII., p. 227, and Peach, *ibid.*, Vol. L., p. 661.

‖ *See* J. F. Blake, "Monian Rocks of Shropshire," *Quart. Journ. Geol. Soc.*, Vol. XLVI. (1890), p. 391; Geikie, *Geol. Mag.*, 1891, p. 499.

* "The Student's Lyell" (1896), p. 563.

aside, because it may never come entirely within our grasp. The real problem at the present day lies in the amazing completeness of the Lower Cambrian fauna, and in the trivial nature of the discoveries that have been made in underlying strata. Setting aside the once famous *Eozoön*, which is itself a crystalline metamorphic rock, we know of possible radiolaria in Brittany, obscure brachiopods from the Longmynd, and a slightly more hopeful series of remains from Arizona.* These last include, to quote Mr. Walcott, "a small Patelloid or Discinoid shell, a fragment of what appears to be the pleural lobe of a segment of a Trilobite, and an obscure, small Hyolithes." Lower down, "an obscure Stromatoporoid form occurs in abundance." The caution of the above sentences is noteworthy. If the suggested determinations become fully verified, we have here a brachiopod, a trilobite, a pteropod, and a hydrozoan. Similarly uncertain remains have been found in Canada and Newfoundland. North-west India, however, now seems to offer a better field.

The one thing positive about Precambrian life is the prevalence and antiquity of annelids. Traces of worms have been everywhere recorded; and other soft-bodied animals have left tracks, which are difficult enough to decipher.† On zoological grounds, worms occupy an august position in the long chain of animal life. Mr. H. M. Bernard‡ derives such highly organised creatures as the trilobites from a "browsing annelid, with first segment bent round, and lateral projections." The argument connecting the existing crustacean *Apus* with *Olenellus*, and both with their "richly segmented annelidan ancestor," forms a highly instructive chapter in palæontology. In his later paper, Mr. Bernard even affirms that "the crustacea can now be linked, step by step, with the chætopod annelids." To him, looking far back into undiscovered faunas, the trilobites themselves appear as "browsing armoured annelids," their ancestors behind them having possessed sixty to seventy segments, and having been genuinely worm-like. But what of the ancestry of these worms themselves? The pages of the vast Precambrian history must be turned with hesitating slowness.

The stimulus for research is found at once when we consider the Lower Cambrian fauna. We have there so much to account for—so much that cannot have sprung, full armed, from mother earth. Walcott's review of this fauna,§ with his fine series of plates, shows how complete our knowledge has become. To begin with, we have sponges, including the spicular mesh of the well-known *Protospongia* of Wales; early types of corals, which were formerly classed as sponges; hydrozoa, represented by graptolites, and by strange dark markings and siliceous bodies, which are believed to be internal casts of jelly fish.‖ A few plates of a cystidean, one of the primitive sea-lilies, have been discovered in America. The brachiopods have long been known, including *Kutorgina* in our Hollybush Sandstone, and *Lingulella*, an ancestor of the still surviving *Lingula*. In Britain, the oldest lamellibranchs are in the Upper Cambrian; but bivalve molluscs actually occur in the *Olenellus*-zone of North America, and form one of the more surprising features of the fauna. If the lamellibranchs are regarded as degenerate molluscs, their degeneration must have taken place during the Precambrian ages.

Then we have gastropods, including even *Pleurotomaria*, which attained its full development in Jurassic times, and which is still represented by four species in the warm seas of the present day. *Hyolithes*, a common Palæozoic fossil, is generally treated as a pteropod, but brings us to the verge of the cephalopods, and caps this molluscan series. Higher animals are represented by the trilobites.

Of these we already know some fourteen genera, including the zone-fossil, *Olenellus*. Species of *Olenellus* have been multiplied of late, and have been named after workers in this difficult Cambrian field. The species here figured (Fig. 1), *Olenellus Thompsoni*, was described from Parker's Quarry, Vermont, by James Hall in 1859, and was made by him,* in 1862, the type of the genus *Olenellus*.

Fig. 1.—*Olenellus Thompsoni*. Lower Cambrian. From Parker's Quarry, Georgia, Vermont, U.S.A. From a specimen presented by the U.S. Geol. Survey to the Royal College of Science for Ireland. (The head-shield has become pushed back slightly, the large body-segment being in reality the third.)

We have, then, in the lowest Cambrian a rich invertebrate fauna, primitive in some respects, but still far from being primordial. A sea in which fishes had not yet arisen, a world which was dominated by quaint crustaceans some four or five inches long, seems very far removed from the conditions of the present day. But when, on the other hand, we consider the time required to differentiate the groups of the mollusca, to encase the cystidean in his plated calyx, to define the genera of the trilobites, so that *Olenellus*, "richly segmented," lies side by side with the dwarfed and specialized *Agnostus*, then we may see in the *Olenellus*-zone the beginnings of our modern fauna. The secret beyond that zone spreads out through immeasurable ages. It is written, as it were, on a torn papyrus, the fragments of which lie scattered round about the globe. At length some skilful worker may fit two lines together, though their position in the whole document may still remain unknown. Yet such a couplet would be for him the triumph of a life-time.

Notices of Books.

The Native Tribes of Central Australia. By Professor Baldwin Spencer and F. I. Gillen. (Macmillan & Co., Ltd.) 21s. net. Whoever takes up this book with the hope of finding within its pages a thrilling narrative of life and adventure among the blacks of Central Australia will be grievously disappointed. Not so the serious student of anthropology, who will discover in it a veritable storehouse of information regarding the manners and customs of the aborigines. It is not often that we meet with so happy a combination of authors; Mr. F. I. Gillen, the special magistrate and sub-inspector of the aborigines at Alice Springs, S. Australia, has had, through his knowledge of the language, and the confidence he has inspired among the natives, unrivalled opportunities of making himself familiar with their most secret ceremonies and traditions, whilst Professor

* C. D. Walcott, "The Fauna of the Lower Cambrian or Olenellus Zone," *Tenth Ann. Report U.S. Geol. Survey (1890)*, p. 552.

† Photographic representations of similar markings in Palæozoic rocks are well given in Sir W. Dawson's paper in *Quart. Journ. Geol. Soc.*, Vol. XLVI., p. 595.

‡ "On the Systematic Position of the Trilobites," *Quart. Journ. Geol. Soc.*, Vol. L., p. 430; also *ibid*, Vol. LI. (1895), p. 358.

§ *Tenth Rep. U. S. Geol. Survey*, pp. 515—658.

‖ Walcott, *Monographs U.S. Geol. Survey*, Vol. XXX. (1898).

* *Fifteenth Report, N. York Cabinet of Nat. History*, p. 114.

Spencer, the distinguished teacher of biology at the University of Melbourne, has brought to bear upon the many problems considered the influence of his scientific training, thereby sifting the evidence and setting aside as untrustworthy much that is mere hearsay. The result of this co-operation is a remarkable book, noteworthy for the painstaking care displayed in every chapter as well as the guarded conclusions therein expressed. In the description of the various ceremonials, no details, however trivial, have been omitted, and we have in consequence a much fuller and more accurate account of what takes place at these "functions" than has hitherto been presented to us. This, together with the remarkable series of photographs with which the work is illustrated, serves to place the book in the forefront of the literature relative to the ethnology of Australia. In various chapters the authors treat of the social organization of the tribes, the totems, the various ceremonial proceedings, the myths concerning the origin of the tribes, and the customs relating to marriage, burial, mourning, etc. The general reader will find the description of the social organization of the tribes a very stiff chapter to digest; it may well be left to the experts in these matters. More interesting, from a general standpoint, is the account of the totems; our authors incline to the view that in regard to the particular tribes with which they are dealing, this peculiar custom is in some way related to the food supply. "It is quite possible," say they, "that the curious ceremony in which the members of any local group bring into the men's camp stores of the totemic animal or plant, and place them before the members of the totem, thus clearly recognizing that it is these men that have the first right of eating it, as well as the remarkable custom, according to which one man will actually assist another to catch his, *i.e.*, the former's, totemic animal, may be surviving relics of a custom, according to which in past times the members of a totem not only theoretically had, but actually practised the right of eating their totem." Concerning their "Medicine men," the natives seem to be in advance of the times, for women as well as men are eligible for the "profession," having to undergo the same initiation ceremonies and become subject to the same restrictions. Startling, too, are the remarkable instances recorded by the authors in which the mind seems to exercise an all powerful influence over the body. Three cases are quoted in which men were so slightly wounded that there was absolutely no reason why they should not speedily recover; so convinced were they, however, that the weapons they had been wounded by were "sung" to, or subjected to the influence of magic, that they all made up their minds to die, and this, in the words of the authors, they "accordingly did." On the other hand, a man, even though severely wounded, would make a rapid recovery provided he was satisfied that no magic had been practised on him. The various methods of obtaining wives by magic, as also the instances of what appears remarkably like thought transference, are no less curious, but those interested in this and other subjects must be referred to the book itself. A valuable addition to the volume is the series of measurements given of twenty males and ten females. We congratulate the authors on the completion of a work which has been undertaken and carried through under many difficulties, and it is with pleasure that we accord to them our hearty thanks for this trustworthy addition to our knowledge of the ethnology of the Australian tribes.

Skertchley's Elements of Geology. 9th Edition. Revised by Dr. James Monckman. (Murby.) Illustrated. 1s. 6d. As a class-book, Skertchley's Geology has sustained a good place among many competitors, and we are glad to see it revised by so able a man as Dr. Monckman. The science is so progressive, and, what is more to the point in this case, the syllabus of the Science and Art Department is so ephemeral, that radical changes in the text are often required to keep pace with the modifications thus rendered inevitable. The new matter comprises chapters on Rock-forming Minerals; Crystallography; Volcanic and Plutonic Rocks; and the Microscopic Examination of Rocks. Also many new illustrations have been interpolated in the text, but as far as circumstances would permit, the original author's impress on the work has been left undisturbed.

The Farmer and the Birds. By Edith Carrington. (Bell.) The author's aim in this book has been to show, by bringing together a considerable amount of evidence regarding the food of birds, that apparently all birds do infinitely more good than harm. While agreeing with a great deal that Miss Carrington says, we do not consider that she has struck a just balance with regard to several of the birds with which she deals. It is very likely the case that all birds, provided their numbers are kept within due proportion, do more good than harm, but in this book the good is positively pronounced as great, while the harm is minimised or considered uncertain. The destruction of game by birds has not been considered an offence, because "game is a luxury," but in a book appealing to farmers, to whom game is often a source of income, this exclusion is absurd, and will do the author's case no good. Of the number of "authorities" which are quoted some have been inadvisedly chosen. We have no wish to throw cold water upon Miss Carrington's endeavours, which are deserving of all praise and support, but she herself wishes the question to be faced fairly, and this, we think, has hardly been done in the little book before us.

The Science of Life. By J. Arthur Thomson, M.A. (Blackie.) 2s. 6d. As Mr. Thomson remarks in his preface, "this little book bears a big title," but the author does not attempt to solve the stupendous riddle of existence. The book is intended simply as a historical sketch of the growth and development of biological science, and as such it is a very valuable production. All students of biology should possess a work of this kind, which gives, so to speak, genealogical trees of every branch of the science—classification, morphology, physiology, embryology, heredity, bionomics, psychology of animals, evolution, and so on; shows us who has taken part in bringing our knowledge of these subjects to its present condition, from Aristotle's time to our own day; brings before us contemporaries in all ages who have formed the scientific senate, as it were, and evolved for us laws, theories and beliefs which, like the acts of our Legislature, have undergone many transformations in conformity with the progress of advancing civilization and the amplification of knowledge.

Quæro. By James H. Keeling, M.D., F.R.C.S. (Taylor and Francis.) For private circulation. An essay in which certain questions relating to matter, energy, intelligence and evolution are discussed, the purpose being to ascertain whether recent advances in physical and biologic science can be held to have shaken the grounds for the old faith in the existence and rule of a Supreme and Intelligent Power." It is written in popular form, and thoughtful, educated people, though not deeply versed in science, will probably be able to gauge the value of the arguments advanced. The author exhibits a profound knowledge of scientific questions, and the reader, whether he accepts his views or not, will be repaid for time spent in the perusal.

The Principles of Stratigraphical Geology. By J. E. Marr, F.R.S. (Cambridge University Press.) Illustrated. 6s. A correct chronology is of paramount importance to the student of earth-lore, for the history of our planet, like other histories, is a connected one in which one period is linked on to the next, and it is the aim of the stratigraphical geologist to record the events which have occurred during the existence of the earth in the order in which they have taken place. In order that the student may not be confused with the multifarious details usually accompanying descriptions of the stratified rocks, the author has given very concise accounts of the strata of the different systems, showing the skeleton only—if we may use the expression—of the solid crust. This is as it should be for the beginner in such a subject, which demands the exercise of imagination as well as common sense, and too much explanation, like too much salt, may blunt the edge of one's appetite.

Through Arctic Lapland. By Cutcliffe Hyne. (A. and C. Black.) Illustrated. In his preface to this book the author claims to have "stumbled across the one bit of Europe which has not been pilloried on paper at one time or another." We wish there were such a place in Europe, but we are afraid there is not. Mr. F. L. H. Morrice, in the "Nightless North," published in 1881, deals with a journey undertaken by himself and a friend from Vadsö to Torneo at the head of the Gulf of Bothnia. Mr. Hyne, accompanied by Mr. C. J. C. Hayter have traversed Lapland between the same points, but they have taken a route some few miles to eastward of Mr. Morrice's route. Mr. Hyne writes in a most graphic, emphatic style, and it is a great pleasure to read his epigrammatic and often very humorous pages. We have some shrewd remarks on the characters of both Lapps and Finns, and a good description of their country. Like

Mr. Morrice, and everyone else who has written of Lapland, our author devotes many pages throughout the book to mosquitoes. Mosquitoes, bogs, want of food, the laziness of the Lapps, and scarcity of carriers seem the chief evils of this country, and Mr. Hyne does full justice to them. The book is well worth reading, but it tells us little that is fresh. The illustrations, which are the work of Mr. Hayter, are for the most part excellent.

Diet and Food. By Alex. Haig, M.A., M.D. (Churchill.) Illustrated. 2s. A rational system of supplying the human machine with food, although of the utmost importance, is for some unaccountable reason entirely ignored by the great majority of the British public. Even among the more enlightened, far too little attention is devoted to the advantages which follow in the wake of a course of dieting suited to the varying needs of the body at different periods of life. Dr. Haig endeavours to impress on the minds of his readers the necessity for varying the diet at different stages of life. The food required for youth, he contends, will not answer equally well in old age, neither will the diet adhered to by persons in active outdoor life suit persons of sedentary habits. In this way the doctor goes into the subject thoroughly, touching upon many phases of human life, and projecting the light of science thereon in a manner which is decidedly instructive and agreeable reading at the same time. Careful perusal of such books as this will help to minimise the evils arising from ill-regulated gastronomic operations—disease in many forms, the agony of a deranged digestive system, and premature death.

We learn from Mr. Davies, of Brecon, that he is publishing by subscription a volume on "The Birds of Breconshire," by Mr. E. Cambridge Phillips. The price of the book to subscribers will be 7s. 6d.

BOOKS RECEIVED.

Primitive Constellations. Vol. I. By Robert Brown. (Williams and Norgate.) Maps. 10s. 6d.

The Story of the British Race. By John Munro. (Newnes.) 1s.

Laboratory Manual in Astronomy. By Mary E. Byrd. (Ginn and Co.) $1·35.

Truth and Error. By J. W. Powell. (Kegan Paul.) 9s.

On Centenarians. By T. E. Young, B.A. (Chas. and Edwin Layton.)

An Introduction to Stellar Astronomy. By W. H. S. Monck, M.A., F.R.A.S. (Hutchinson.) Illustrated. 3s. 6d.

Haunts and Hobbies of an Indian Official. By Mark Thornhill. (Murray.) 6s.

Chemistry for Photographers. 2nd Edition. By Charles F. Townsend. (Dawbarn and Ward.) Illustrated. 1s. net.

The Practical Electrician's Pocket Book and Diary—1899. (Rentell & Co.) 1s. net.

The Naturalist's Directory, 1899. (Upcott Gill.) 1s. net.

Chapters on Human Love. By Geoffrey Mortimer. (University Press, Limited.) 10s.

The Life Story of Sir Charles Tilston Bright. By Edward and Charles Bright. 2 Vols. (Constable.) Illustrated.

Funafuti, or Three Months on a Remote Coral Island. By Mrs. Edgeworth David. (Murray.) Illustrated. 12s.

The Resources of the Sea. By W. C. McIntosh, F.R.S. (Cambridge University Press.) Illustrated. 15s. net.

History of Physics. By Florian Cajori, PH.D. (Macmillan.) 7s. 6d.

Eclipse Observations taken at Dumraon, 22nd January, 1898. By Rev. V. de Campigneulles, S.J. (Longmans.) Plates. 10s. 6d. net.

The Internal Wiring of Buildings. By H. M. Leaf. (Constable.) Illustrated. 3s. 6d.

Early Chapters in Science. By Mrs. W. Awdrey. (Murray.) 6s.

Report of the Australasian Association for the Advancement of Science, 1898.

Harold Hardy. By F. C. Huddle. (University Press, Limited.) 6s.

The Scientific Roll. A Magazine conducted by A. Ramsay. (O'Driscoll, Lennox & Co.) 1s.

Science Notes.

Most observers are agreed that before a great storm birds which sing are more restless than usual. During one of the nights of August, last year, there was a very severe storm, accompanied by wind, rain, thunder, and lightning, which prevailed over a considerable part of Illinois. For forty-eight hours before the storm broke, Mr. W. Warner, of Henry County, U.S.A., records that not a sound was heard from a single one of the numerous song birds in the district. Other observers declare, however, in letters written to Mr. C. E. Linney, that birds sing more loudly and more persistently in such circumstances. But all were agreed about the restlessness of song birds before a storm. That there is some connection between the conditions of the atmosphere and the behaviour of birds is borne out by some of the proverbs Mr. Linney has collected in his paper on this subject in the *United States Monthly Weather Review*. The following will help to exemplify this connection:—When birds cease to sing, rain and thunder will probably occur.—Robins will perch on the topmost branches of trees and whistle when a storm is approaching.—Parrots and canaries dress their feathers, and are wakeful the evening before a storm.

An ingenious generator of acetylene gas has been patented by Sir Howard Grubb, particularly useful for domestic purposes, or where unskilled labour is employed. The generator, provided with baskets or compartments for the carbide, may be inside or outside of an enclosed tank, but connected therewith in such manner that, as the volume of gas in the container increases, water is displaced and forced up through a pipe to the water supply tank, or, water may flow from a separate tank on to the carbide in such manner that as the gas accumulates the generator is left comparatively dry. The generator, if outside the gas container, is conveniently provided with a water jacket, a precaution which minimises the chances of explosion, and the various valves for shutting off the water inlet, the gas outlet, and the pipe to the waste tank may be automatically operated by springs or other equivalent means by the removal of the cover of the generator when it is necessary to recharge.

The Frena pneumatic release is a new auxiliary to the hand camera. Among other advantages it overcomes the risk of shaking the camera in the act of setting off the shutter; enables an exposure to be made in many positions where it is otherwise most inconvenient; and, with the aid of a long tube and ball, enables the operator to retire to a distance and make the exposure unobserved. It consists of a spring plunger attached to the ordinary tube and ball, and can be clipped on or taken off the camera as required without removing the screws which hold it in position.

Just now, when the Bill relating to the sale of food and drugs is engaging the attention of the Legislature, it is opportune to mention a most useful journal, *The British Food and Analytical Review*, the official organ of the Commission, the object of which is to disseminate authoritative information upon the thousand-and-one ways in which unprincipled tradesmen tamper with commercial products. Public authorities and officials, by consulting its pages, may receive valuable assistance in the administration of the existing laws for the suppression of the malpractices in question, and so give the public proper guidance in regard to food and other useful products.

There is every reason to believe that the proposed National Antarctic Expedition will start in 1900. Grants of one thousand pounds each, it is confidently expected, will be received from the Government Grant Committee of the Royal Society, and from the Council of the British Association for this object. Sir Clements Markham has received a letter from Baron von Richthofen, President of the Berlin Geographical Society, in which he refers to a great and

enthusiastic meeting in connection with the German Antarctic Expedition, and in very explicit terms to the expected co-operation of England in the great work of a thorough exploration of the unknown Antarctic area. At present the total amount available, including the two grants referred to above, is about fifteen thousand pounds, but to equip a satisfactory expedition, with two ships, would require one hundred thousand pounds. It is understood that if twenty-five thousand pounds can be obtained steps will at once be taken to organise a modest expedition with one ship, and so comply to some extent with the desire for co-operation on the part of Germany. With a view to help, the scientific societies in Australia are moving in the matter, with the object of influencing the premiers of the different colonies.

Prof. Pickering has announced by telegram, within the last few days, the discovery of a new satellite of Saturn. An approximate computation indicates that the satellite, a small body of the fifteenth magnitude, revolves in an orbit outside the other eight satellites of the planet, and completes its circuit round the primary in a period of seventeen months. It was by means of photography that this discovery was effected.

The next congress of the South Eastern Union of Scientific Societies will be held at Rochester on May 25th, 26th, and 27th.

British Ornithological Notes.

Conducted by Harry F. Witherby, f.z.s., m.b.o.u.

Fire-crested Wren in Breconshire.—On 27th February, hearing a Crested Wren in my garden with a somewhat different note from the ordinary Gold-crest, my son shot it with a catapult for the purpose of identification, and I found it to be an undoubted Fire-crested Wren. The stripe through the eye, the sort of black moustache from the corners of the mouth, and the black stripe under the crest, with the white between, left no doubt of the bird's identity. I have always thought this bird occurred occasionally with us, and on that account included it in my list of birds of the county, but it was and is much rarer than I at first supposed. I omitted to say that the above bird was a cock, with all his colours of the very brightest, also that when he flew he darted out from the tree and back, something after the manner of the White-throat; he also appeared slightly larger than the Gold-crest. He had another with him, which we secured a few days after, very near the same place where we secured the cock. This was the hen bird, and she was much smaller than the cock, and less bright in all her markings, but they both had the beautiful gold sort of mantle on the sides of the neck. I dare say I shall be blamed for killing this pair of birds, but I have been looking out for the Fire-crest for the last eighteen years and this is the first time I have been able to positively identify it in the flesh as occurring here, as from the incessant movements of both this bird and the Gold-crest one is unable to distinguish the stripes on the head which almost alone marks the difference in the two birds. Mr. Marsden, of Clifton, is preserving them both.—E. Cambridge Phillips, The Rock, Bwlch, Breconshire.

Linota Exilipes (Coues) in Holderness.—On December 30th, 1898, two Mealy Redpoles were shot by a farmer at Skeffling, in Holderness. Both birds were killed at a shot, and the only two seen. They had attracted the man by their light colour and the bright carmine on the breast of the male. These two subsequently came to me through Mr. Philip Loten, of Easington, who set them up. I find they are distinctly referable to the Arctic and circumpolar Redpole, the *Linota exilipes* of Dr. Coues, and are identical with one from the same district which was sent by me to Mr. H. E. Dresser in 1894. There are altogether three species, or, perhaps, only races, of the northern Redpole which have occurred in the Spurn district—the typical *Linota linaria*, which in some years is fairly common; the subject of this notice; and a still larger and lighter coloured bird which inhabits Greenland, *Linota hornemanni, Hölboll.* This latter is figured in Lord Lilford's "Coloured Figures of the Birds of the British Islands" (Vol IV., plate 29), from an example obtained near Spurn in 1883. This, however, is not the only occurrence. On February 25th, in 1892, Mr. Hewetson and I watched for some minutes a most beautiful example (showing more white even than in Lord Lilford's plate) which was clinging to the top of a thistle on Kilnsea Common, close to the sea shore. When first observed it was in company with Snow Buntings, which flew away leaving it clinging to the thistle head, and permitting us a very close approach. Another was obtained near Kilnsea in 1893, and also sent to Lord Lilford.—John Cordeaux, Great Cotes House, R.S.O. Lincoln.

Correction.—Macqueen's Bustard (*Otis Macqueeni*) in Aberdeenshire.—The Bustard shot by Mr. J. G. Walker on October 24th, 1898, at St. Fergus, and unfortunately recorded in the *Annals of Scottish Natural History* (see Knowledge, February, 1899, page 42) as a Little Bustard, now proves to be a specimen of Macqueen's Bustard. This bird, which is a female, is only the fourth example of the species which has occurred in Great Britain. The first was obtained in Lincolnshire in 1847, another was shot near Redcar, in 1892, and the third, which I had the pleasure of seeing alive, was shot in Holderness, Yorkshire, in 1896 (see Knowledge, November, 1896, p. 251). All four specimens of this wanderer from Asia appeared on our east coast in the month of October. —H. F. W.

King-Eider in Shetland (*The Field*, March 11th, 1899, p. 356).—Mr. J. E. Harting has examined a specimen of *Somateria spectabilis* which was shot near Lerwick, on February 25th, and sent to Mr. Rowland Ward for preservation. Mr. Harting remarks that in this specimen the bill was rose-pink, the cere bright lemon, the toes orange, with the interdigital membranes dusky. The King-Eider, which is a very beautiful bird, inhabits the Arctic Regions, and its visits to our coasts are rare.

Mallard and Pintail Hybrid.—At a meeting of the British Ornithologists' Club, held on February 15th, the Rev. H. A. Macpherson exhibited a nestling Duck, which was the offspring of a female *Anas boscas* and a male *Dafila acuta.*

Red Grouse and Bantam Hybrid.—At a meeting of the British Ornithologists' Club, held on February 15th, Mr. J. G. Millais exhibited an extraordinary hybrid between a male Red Grouse (*Lagopus scoticus*) and a female bantam fowl.

Barred Warbler in Lancashire (*The Naturalist*, March, 1899, p. 75).—Mr. W. Ruskin Butterfield records that a male example of *Sylvia nisoria* was shot by Mr. A. P. Page, near Fleetwood, on August 20th, 1898.

All contributions to the column, either in the way of notes or photographs, should be forwarded to Harry F. Witherby, *at 1, Eliot Place, Blackheath, Kent.*

Letter.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

LOCUSTS IN ENGLAND.

To the Editors of Knowledge.

Sirs,—During the last week three live locusts have been taken in imported vegetables.

The first at Hampstead, on the 11th inst., by a green-

grocer. This insect is now at the Zoological Gardens, Regent's Park, and is doing well.

The second at Blackheath, on the 13th inst., by a greengrocer, in cauliflowers that had come from Italy. I sent it to the Zoological Gardens, where it unfortunately died. Mr. Thomson, the Assistant Superintendent, writes me that he believes it is the migratory locust *(Pachytylus migratorius)* of south-east Europe.

The third at Highgate, on the 15th inst., by a greengrocer, in a case of Algerian bananas. It is now in the school museum of the Highgate Board School.

From the descriptions I conclude all three are of the same species. Jos. F. Green.

West Lodge, Blackheath,
18th March, 1899.

Obituary.

We greatly regret to note the death, on March 5th, of Miss Elizabeth Brown, of Further Barton, Cirencester. Miss Brown has been well known in astronomical circles for many years as a most careful and industrious amateur astronomer. Her favourite subject of work was the sun, and she became Director of the Solar Section in the Liverpool Astronomical Society in 1883, and on the formation of the British Astronomical Association she was at once invited to fill the same post. In this Association she was a most indefatigable worker and a most generous contributor to its funds. The problems offered by solar eclipses also attracted her attention, and she made three long journeys to Russia, to the West Indies, and to Lapland, in order to take part in their observation. On only one of these three occasions, however, was she favoured by a sight of the phenomenon. Two charming little books, written by her sister and herself, and entitled respectively "In Pursuit of a Shadow," and "Caught in the Tropics," narrate the experiences of the first two of these expeditions. She contributed many papers, chiefly on solar matters, to the Liverpool Society and the British Astronomical Association, beside the preparation in seven successive years of annual reports on the daily state of the sun's surface. These latter were illustrated by drawings of sunspots largely from her own hand, which are of extreme beauty and truth. Her sudden death is an irreparable loss to the Association, in which she had made a large number of personal friends.

By the death of Sir Douglas Galton, science loses from its front ranks a gentleman whose name is intimately associated with the sanitary advancement of our time. Born in 1822, he entered the Royal Military Academy, at Woolwich, at the age of fifteen, and there distinguished himself by taking the first prize in every subject. In 1847 he became secretary to the Railway Commission that investigated the application of iron to railway structures, and subsequently became an inspector of railways and secretary of the Railway Department of the Board of Trade. When, in 1857, Metropolitan drainage was under consideration, Captain Galton was one of the referees. In 1859 he was appointed Assistant Inspector-General of Fortifications, and, in 1862, Assistant Under-Secretary for War. Sir Douglas was elected a Fellow of the Royal Society in 1863, and, in 1870, General Secretary of the British Association. Oxford conferred on Sir Douglas its honorary degree, D.C.L., and Durham its LL.D. Few men have sat on so many commissions, or been oftener connected with the great public exhibitions as judge of awards or member of executive council. He was an authority on hospital construction, on the drainage of towns, on all subjects which are open to arbitration as between railway companies, who often chose him for arbitrator. His services to the British Association were recognized in his election to the Presidency in 1895. Foreign orders were lavishly bestowed upon him.

A NEW FORM OF PHOTOGRAPHIC TELESCOPE.

A GREAT number of very large telescopes of nearly the same form have been given to observatories during the last few years. Although such instruments are indispensable, in a limited number of investigations, yet when the latter are divided among so many telescopes the results obtained by each are often disappointing to the donors. These instruments have been erected, with two or three exceptions, in places selected from local or political motives, and without regard to meteorological or astronomical conditions. For this reason the great observatories of the world are near large cities or universities where the very conditions that have rendered the countries great have rendered them unfit for the most delicate astronomical research. Nine-tenths of these instruments are in the temperate zone in Europe and the United States, while the southern hemisphere has been entirely neglected, and many of the most interesting parts of the southern sky have not yet been examined by a modern telescope of the largest size.

This duplication of expensive instruments in unsuitable localities is rendered still more objectionable by another condition. All the telescopes are similar in form, their focal length being from fifteen to eighteen times the aperture, and therefore all are best adapted to the same kind of work. In view of these numerous precedents it was a bold step to deviate from it; but this step was taken, and taken by a woman, Miss Catherine W. Bruce, of New York, who gave fifty thousand dollars to the Harvard College Observatory to construct a telescope of twenty-four inches aperture, in which the focal length should be only six times the length of the aperture. Fortunately, this experiment succeeded, and the Bruce Photographic Telescope is mounted in Arequipa, Peru, in a climate unsurpassed, so far as is now known, for astronomical work. Its immediate results are charts, each covering a large part of the sky and showing such faint stars that four hundred thousand appear upon a single plate. By its aid many new stars of the peculiar fifth type have been found in the Large Magellanic Cloud, showing an additional connection of this object with the Milky Way. A group of forty nebulæ, hitherto unknown, has been found in another part of the sky. The most important work of the Bruce telescope, however, is that every year it sends hundreds of photographs to the great storehouse at Cambridge. Besides the immediate discoveries made from these plates, they doubtless carry with them many secrets as yet unrevealed, and many images of objects of the greatest interest yet to be discovered. A striking example of this kind is found in the recent discovery of the planet Eros, which, next to the Moon, is sometimes our nearest neighbour in the heavens. Calculation showed that this planet must have been near the Earth, and therefore bright, in 1894. An examination showed that this object, although not discovered until 1898, had not escaped the Harvard telescopes. Two images of it were found upon the Bruce plates, fifteen upon the Draper plates, and three upon the Bache plates. It can thus be followed through nearly half a revolution. Six images were also obtained in 1896, when it was more distant and much fainter.

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These examples show the advantages of trying new forms of telescopes instead of duplicating those now existing. The Bruce telescope is well adapted to investigations in which the focal length is small; it will therefore be interesting to try the effect of a great focal length. It is proposed to build a telescope with an aperture of twelve to fourteen inches, and a focal length of one hundred and thirty-five or one hundred and sixty-two feet. This telescope would probably be placed horizontally, and the star reflected into it by means of a mirror, and the motion of the Earth would be counteracted by moving the photographic plate by clockwork. It would thus become a large horizontal photo-heliograph. This method of mounting a telescope for use on the stars was advocated by the writer in 1881, and has been used here since then with successive telescopes of two, four, and twelve inches aperture. The instrument here proposed would be adapted to investigations for which a great focal length would be needed, as the latter would be more than a hundred times the aperture. Several such investigations may be suggested, any one of which, if successful, would amply justify the construction of such an instrument.

1. The Sun. The best instrument now in use for photographing the Sun—the horizontal photo-heliograph—is a small instrument of this form. It is possible that, under favourable atmospheric conditions, finer details on the Sun's surface could be obtained with a large instrument than have yet been photographed. It would be equally useful in photographing the protuberances. Preparations must soon be made for observing the solar eclipse of May 28th, 1900. This instrument might be useful in photographing the spectrum of the reversing layer, and in showing the details of the inner corona.

2. The Moon. The images of the Moon obtained with such a telescope would be more than a foot in diameter, and even if printed without enlargement would probably surpass the best photographs yet taken. The use of a telescope of this form for photographing the Moon was advocated by Prof. W. H. Pickering in 1894 ("Harvard Observ. Ann." XXXII., p. 110). It is possible that good results could also be obtained with Jupiter, Saturn, and perhaps Mars.

3. Eros. This planet approaches the Earth so closely that its parallax sometimes amounts to a minute of arc. The next approach, in 1900, will be more favourable than any other until 1927. Careful preparations should, therefore, be made for observing Eros when east and west of the meridian, since the distance of the Sun can probably be determined with more accuracy in this way than by any method of observation yet attempted. As the distance of the Sun is the unit to which all astronomical distances are referred, the importance of its accurate determination cannot be overstated. It is one of the great problems of astronomy, which, though supposed in the eighteenth century to have been solved, must probably be left to the twentieth century for satisfactory solution. To determine the parallax from the Transit of Venus in 1874, the principal nations of the world sent expeditions to the most remote regions. In all about eighty stations were occupied at an expense of more than a million of dollars.

4. The Fixed Stars. It is expected that the positions of adjacent stars could be determined with this instrument with an accuracy approaching that of the heliometer. If so, it would have an important and permanent field of work in charting the coarser clusters, the double stars, and determining stellar parallax; also in locating the major planets, and the relative positions of the satellites of Jupiter and Saturn with an accuracy as yet unattained.

The very moderate expenditure of five thousand dollars to ten thousand dollars would permit this experiment to be tried here, since we already have a portion of the apparatus required. If successful, the name of the donor would always be honourably associated with a new departure in one of the most important branches of astronomy.

February 11th, 1899. Edward C. Pickering.

WIDE ANGLE PHOTOGRAPHY IN ASTRONOMY.

By E. Walter Maunder, F.R.A.S.

ONE of the first results of the great scheme of an international photographic survey of the entire sky was a rather curious one. There was a sensible diminution in astronomical activity, at any rate in England, apart from the more or less routine work carried on by the great public observatories. This would seem to have resulted from a vague, unspoken, yet powerful impression that the great photographic revolution which was in progress had rendered the older methods of observation more or less obsolete, and in particular had doomed the amateur astronomer to uselessness and extinction.

In all probability, no one man ever formulated this impression into a categorical statement, but for a time it certainly had its effect. Nor was it without some plausibility, for it was a new thing to see an astronomical enterprise set on foot of so gigantic a nature that no single observatory, however fully equipped and richly endowed, could hope to deal with it. Nothing less than the association of something like a score of the largest observatories in the world could cope with it.

The discouragement did not last long, and there were some who never felt it. Dr. Isaac Roberts, for instance, was very quick to realize that the international scheme had by no means annexed the whole of the photographic universe, and he promptly carved out a territory for himself, which he has developed with a thoroughness and a success which requires no setting forth to the readers of Knowledge, who have had the privilege of studying so many of his wonderful revelations of world systems in the making.

Here, then, are two great photographic surveys with entirely different objects, carried out by very dissimilar instruments, but both carried out so effectively as to render any thought of competition quite out of the question, save to extend Dr. Roberts' cluster and nebular studies to the Southern Pole.

Do these two great schemes cover the whole of possible photographic research? It might almost appear that with some astronomers there had been a feeling that this was indeed the case. If so, others have not been wanting who have been most active in opening out new lines of work.

Amongst the pioneers of new photographic enterprise two names are pre-eminent, those of Prof. Barnard and Prof. Pickering. The impetus which the former has given to the use of the portrait lens in astronomical photography is well known, whilst the latter has been especially fertile in devising new departments of work and new forms of telescopes to carry them out. The present number of Knowledge, for instance, has an article from him on the use of photographic telescopes of extremely long focus. But we would now specially refer to the recognition by Prof. Pickering of the necessity, not only for one great survey of the sky, carried out once, and once for all, but

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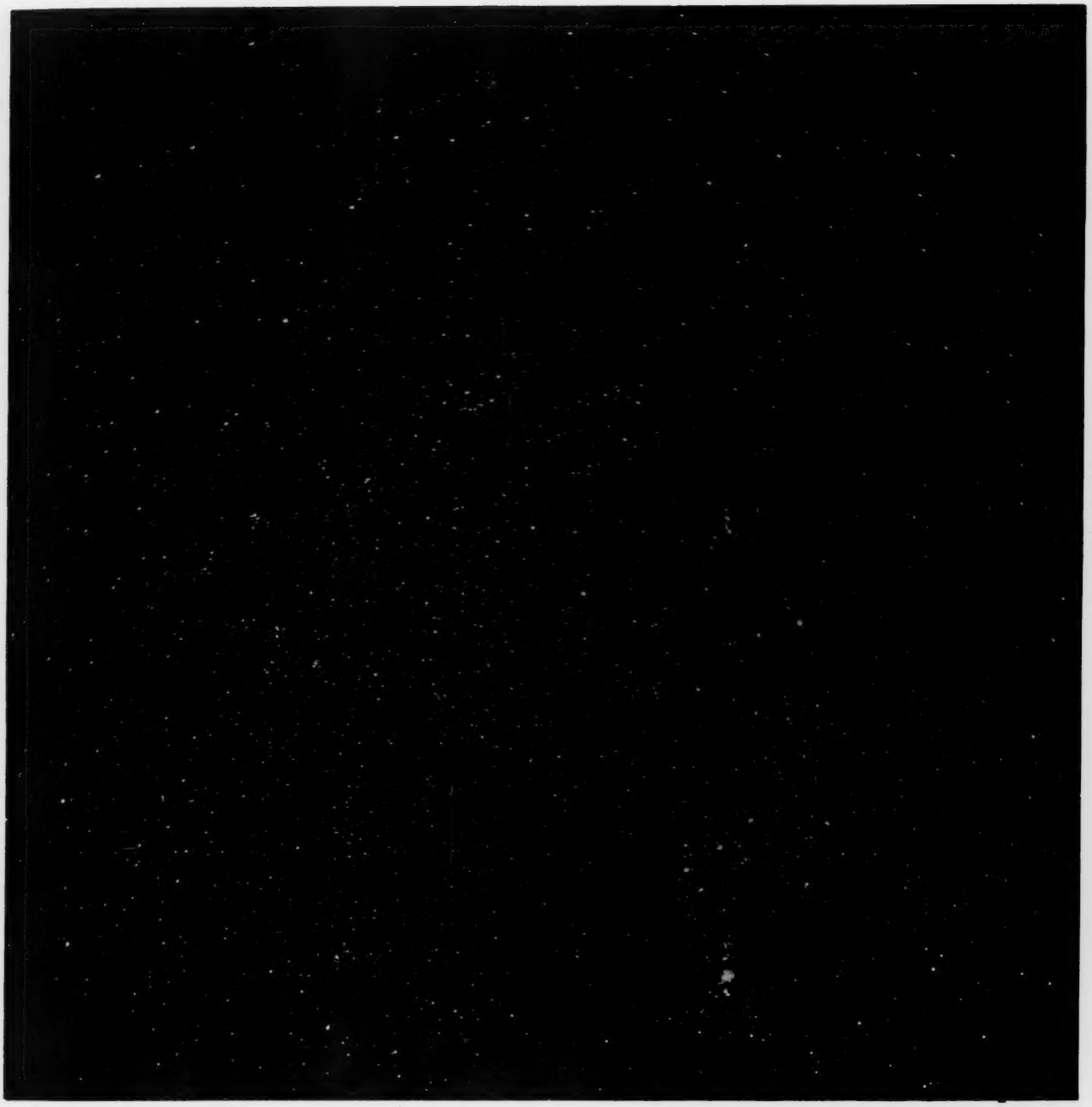
NORTH.



EAST. WEST.

SOUTH.

ONE-THIRTIETH OF THE SKY.

From a Photograph taken by Mrs. WALTER MAUNDER with a Dallmeyer Stigmatic Lens of one and a half inches aperture.

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for surveys made in a short time and repeated at frequent intervals. Such surveys are useful for several purposes. The detection of new planets, of variable stars and Novæ, can only be satisfactorily carried out by schemes of which such frequent surveys form an integral part. Prof. Pickering, therefore, early devised an ingenious method by which the same plate might be exposed to many different parts of the sky and record the stars in each region in so distinctive a manner that no confusion need take place between the different images from each.

There are two fields of work in which the necessity for embracing a large area of the sky upon a single plate is even greater than in that of the search for variables or Novæ, and yet in which the device of repeated exposures would be absolutely useless. These are the two departments of the study of general stellar distribution and of meteor observation.

The former subject was one in which Mrs. Maunder took a great interest. It was apparent to her that fields of five or ten degrees in breadth were insufficient for the purpose of dealing with some of the problems of sidereal architecture. Regions much wider must be brought together upon a single plate, and that, too, without serious distortion, if the work was to be carried out in the most effective manner. There did not seem to be any lens in the market meeting this requirement until Mr. Dallmeyer, whose work as a photographic optician is so well known, brought out his stigmatic lens, covering an unusually wide field. Consequently she applied to Mr. Dallmeyer for one of his lenses immediately upon their details being published, that is to say, early in 1897. It was with this lens—one and a half inches aperture and nine inches focal length—that the photographs were taken of the solar eclipse of January last year, which appeared in Knowledge for May, 1898. The lens was, however, not procured for eclipse work, but for the charting of wide sky areas; its employment in eclipse work was incidental only, and a portrait lens would probably have been more effective, since a considerably higher ratio of aperture to focus might have been obtained.

The accompanying plate may serve to illustrate two of the uses to which a lens of this kind might be put. The field shown is thirty-seven degrees in side, fifty degrees in diagonal, and includes one-thirtieth of the area of the entire sphere. The plate was chosen for reproduction quite at random, and is far from being the best available. Nevertheless it cannot, I think, be in the least contested that it shows the largest field, by much the largest field, of stars defined throughout that has ever yet been published.

The part of the sky depicted is at once apparent, being that which has its centre about 5h. 55m. of R.A. and $8\frac{1}{2}^{\circ}$ N. Dec., and which includes nearly the whole of the constellation of Orion. Stars are seen down to the 10th magnitude, and the nebula round θ Orionis is, of course strongly marked; the much fainter nebula *nf*. ξ Orionis is also very distinctly seen. Two meteors of sufficient brightness to leave a trace fell during the exposure of the plate. One is at the extreme north-west corner of the plate, and only part of the trace is seen. The other is very distinct, and crosses the 17th parallel of N. Dec. about R.A. 5h. 30m.

Considerably more than a year later than Mrs. Maunder's first employment of this wide-angle lens, Prof. Pickering used a similar lens, as described in Knowledge for September, 1898, for the purpose of the detection of short period variables. Circular No. 40, from the Harvard College Observatory, suggests the use of such lenses for meteor observation, and the photograph at once demonstrates its suitability for such work. The mode of operation suggested by Prof. Pickering, and which will shortly be in operation at Blue Hill and at Cambridge, is as follows:—At each station a camera will be exposed to the zenith, each being provided with caps which will close automatically shortly before dawn. About one-third of all the meteors having long paths pass within thirty degrees of the zenith, and all of these, if bright, can thus be photographed. Bright meteor tracks often show points of increased brightness due to small explosions, such as are very noticeable in the meteor in the plate. Such a trail, if photographed at two stations, would give the height of the meteor at the moment of explosion. If the cameras were mounted equatorially, their radiant point could be fixed with great precision. Prof. Pickering goes on to suggest that the use of a prism in front of the lens would secure the spectra of bright meteors, and adds that by the expenditure of three plates a night it seems possible to determine the altitude, radiant point, velocity, and spectrum of one-third of all the bright meteors visible in a given locality. It is probable that several meteors bright enough to be photographed in this way appear every month.

To sum up, then, this new departure in stellar photography offers the following advantages:—Considered merely as photographs of the heavens, a set of forty plates of the same angular field as the one here shown, but of larger scale, would provide a more complete map of the heavens than any we yet possess, in exceedingly small compass, and at very little trouble or expense. The scrutiny of such a set of plates would give us the fullest possible development of that method of attack of the great sidereal problem which Herschel first attempted in his gauges. Indeed, a vast amount of information as to sidereal structure would result from the mere inspection of such plates. Their value in the work of discovery is most obvious. The systematic employment of wide field plates at a number of observatories would ensure the record of all asteroids, comets and Novæ within the limits of magnitude recorded; whilst the ingenious methods which Prof. Pickering has devised will bring about nothing short of a revolution in the discovery of short period variables and the observation of meteors. Much of this work, too, can be done with lenses of small size and therefore little cost, and so lies quite within the powers of many owners of small observatories. For instance, two friends situated north and south of the equator respectively, might easily and at a trifling expense, bring out not only a complete chart of the heavens, embracing over a million stars, but might bring out a new edition every year.

THE KARKINOKOSM, OR WORLD OF CRUSTACEA.—VIII.

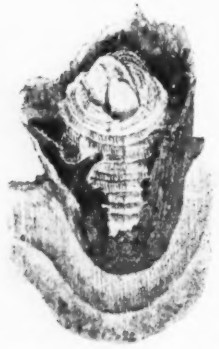
By the Rev. Thomas R. R. Stebbing, M.A., F.R.S., F.L.S., F.Z.S., *Author of "A History of Crustacea," "The Naturalist of Cumbrae," "Report on the Amphipoda collected by H.M.S. 'Challenger,'" etc.*

THE DOOR-SHELL CRUSTACEA, OR RINGLET-FEET.

THE sailors who moored their boat to a whale's back, mistaking it for an island, were abruptly undeceived when they proceeded to light a fire upon it. Cirripedes of sorts treat the massive beast with no more ceremony than the sailors did, and take liberties with better success. They land upon it and embed themselves either at the surface or within the whole thick-

ness of its hide in a way that takes no denial. It might be thought that the whale would find some opportunity of rubbing off these troublesome intruders and excrescences, but even museum specimens will show the futility of any such expectation. The deeply burrowing kinds are quite sheltered from any friction short of that which would scarify their host, in which case the mighty Samson would pay dearly for the ruin of his tormentors. The *Coronula diadema* has a superficial foothold. But examine the base of a specimen. Its numerous radiating compartments are occupied by a sort of black putty. That putty is whale-skin, which the rightful owner would have to part with in rubbing off the Cirripede. Here, too, the remedy would be worse than the disease, and we have striking proof that recourse is not taken to this mode of relief. For on the *Coronula* there is sometimes quietly seated a stalked Cirripede of large size, which would fall like a ripe fig at the least concussion, but which has obtained a practical assurance that, wherever else the rubs of life may be arranged by or for a whale, they are not likely to be at the point occupied by a *Coronula*.

Securely embedded in the skin of a Manatee, the *Platylepas bissexlobata* may for ages have been exploring the rivers of West Africa, but, apart from such rare exceptions, it is singular that hitherto this varied and extensive group of crustacea should have neglected to occupy the fresh waters of the world, for to the utmost limits of maritime dominion it spreads its colonies with a supreme indifference to the character of the supporting basis. Deep down on the floor of the ocean, high up on rocks which only the spray of a spring-tide can reach, on bathing machines, on floating bottles or logs of wood, or in masses of seaweed, on the smooth iron sheathing of a ship, in rocks, in corals, in sponges, in narrow tunnels burrowed into shells, attached to the spines of sea-urchins, clinging to the feathers of sea-fowl, on the backs of sea-snakes, of turtles, of crabs, fringing the very jaws of crawfish and other crustaceans, sometimes conspicuous, sometimes concealed, sometimes solitary, sometimes crowded and multitudinous, coating vast surfaces of the wave-beaten shore, they assert themselves as citizens of the world, of which they occupy a far more extensive tract than man does. The human organism, with its incomparable superiority of brain, is, on the other hand, excessively hampered by a fastidious conservatism in regard to outward form. As Darwin said of the goose, so may it be said of man—that his organization is very inflexible. That is where the Cirripede has had the advantage of us, as a little reflection will suffice to prove.



Tubicinella trachealis Shaw, in skin of Right Whale. (Two-thirds nat. size.)

The Crown Cirripede (*Coronula diadema*) is, as its name implies, a stately form, proper for the pageantry of life, not needing to hide its light under a bushel. But supposing that by the exigencies of existence it were reduced to burrowing into an oyster shell, its massive walls and spreading plumes would be simply a nuisance. Æsop might then have used it—instead of the antlered stag in a thicket—to point the moral of his fable against conceit. But, untaught by Æsop, some of our Thyrostraca (door-shells) or Cirripedia (ringlet-feet) have learned to cast off everything that their alternative names suggest—shells and valves, and feet and ringlets; everything that may be regarded as specially characteristic—in order to live, as if it were better to live without a character than not to live at all. They come down, as it were, from the castle to the cottage, from the cottage to multifarious lodgings, often of the humblest kind, and end in a degraded pauperism, wherein, from their shape and habits, they may, without libel or slander, be described as blood-sucking sausages. The division to which these last belong is known as that of the Rhizocephala, meaning that their heads have been turned into roots, the so-called roots being narrow processes which penetrate the soft part of their host, such as a common shore crab, and derive nourishment from it.

For many of the genera and species, the attachment to an endless variety of moving objects sufficiently explains their extensive dispersion. But many of those which love a settled life are also widely spread. This is due to the fact that the young are born free to move, and not averse to travel.

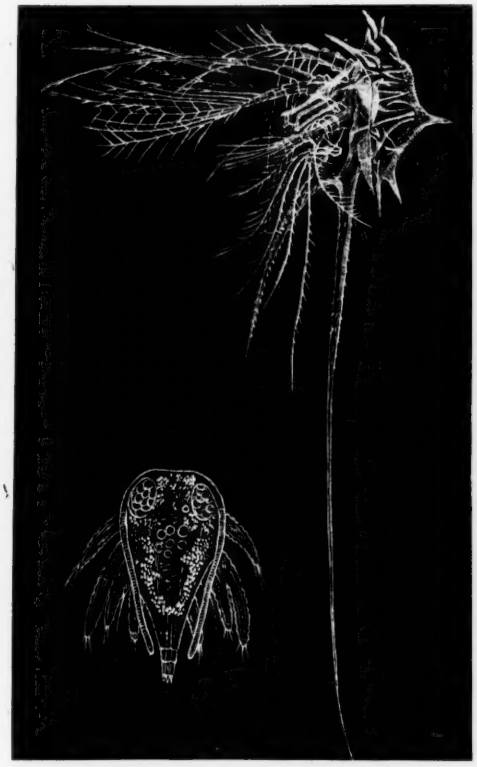
As for Cirripede and Thyrostracan, the giddy world still knows as little about such names as fifty years ago it knew about the centre of Africa. Barnacle seems to be the only name to conjure with. Johnson's Dictionary, a hundred years ago, defined it as "a kind of shell-fish that grows upon timber that lies in the sea," and secondly as "a bird, like a goose, fabulously supposed to grow on trees." As is well known, earlier writers thought the bernicle or barnacle goose from the tree no fable. Sir Robert Moray, for instance (*Phil. Trans. R. S.*, Vol. XI., p. 925), in every shell that he opened found the bird "curiously and completely formed, that there appeared nothing wanting as to the external parts for making up a perfect sea-fowl." "The little bill, like that of a goose, the eyes marked, the head, neck, breast, and wings, tail and feet formed, the feathers everywhere perfectly shaped and blackish coloured, and the feet like those of other water-fowl, to the best of my remembrance." Seeing is believing, and we easily see what we believe. But in natural history it is dangerous to trust to the best of one's remembrance. Also it is not good to trust too much to dried specimens. "All being dead and dry," Moray continues, "I did not look after the inward parts of them." The pleasing hallucination conveyed in this and many similar records is embalmed for the history of science in the names of two species, *Lepas anatifera*, the duck-bearing, and *Lepas anserifera*, the goose-bearing barnacle. Probably the fable did more to awaken and keep alive a popular interest in Cirripedes than any account would have done based on the real wonders of their life-history.

Lepas anatifera Linn.

Lepas anatifera, with tergum and scutum removed.

Though the barnacle never turns into a bird, its free-swimming larva is scarcely more like its adult form than a caterpillar is like a butterfly. At first emergence from the egg-membrane the baby Cirripede is simple in structure and

appearance. It has three pairs of appendages, a mouth, and an eye. It is left to its own resources. There are no breasts for it to suck. There is no fostering nurse. There is no education, primary or secondary. It becomes at once a citizen of the ocean. Its business is to moult as quickly and as often as its growing forces will allow. By successive moultings it comes to assume such a form as that shown in the Nauplius figured by Prof. Chun.* Though the animal at this stage is not awe-inspiring by its size, being only about a quarter of an inch long all told, still its lanceolate armour may make it formidable in some social circles, and the glassy transparence of its caparison invests it with beauty.



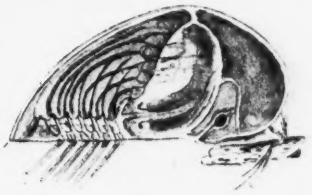
Nauplius of *Lepas anatifera*, shortly before hatching. From Groom.

Nauplius of *Lepas*, sp., just prior to the Cypris stage. From Chun.

Mr. Theodore Groom† considers that the movements of the Nauplius are brought about exclusively by the activity of the three pairs of appendages, propelling it by a series of jerks. These follow one another with great rapidity in the newly hatched Nauplii, but more slowly afterwards. Nature in some way teaches them to husband their resources, and that the business of life should be conducted *ohne Rast ohne Hast*. By this policy, some of them, it is calculated, after the first moult can swim something over two inches in a minute, about a hundred times their own length, equivalent to a mile in eight minutes for a man six feet long. Whether swift or slow, their movements are probably not for any swimming competition nor for the mere fun of the thing. Their throat is said to undergo continuous contraction and dilatation by means of the muscles with which it is furnished, and to constitute a suction pump which causes an intermittent stream of water to enter the mouth. At the same time "the powerful strokes of the three pairs of appendages sweep backwards and inwards any small organisms or particles entangled between the network of hairs and bristles." Mr. Groom seems to have taken a mean advantage of their innocent rapacity, to judge by the following paragraph of his essay:—

"Though the Nauplii of *Balanus*, *Chthamalus*, and *Lepas* refused to eat starch, they greedily took up water containing carmine, indigo-carmine, methyl-blue, litmus, etc. In the case of the first three substances, considerable accumulations were formed after a short time in the stomach and intestine, but the greater part of the carmine was passed out unabsorbed."

The young that are born must be inconceivably numerous. The dangers of their childhood are also innumerable. By dint, however, of energetic feeding and refusing to eat starch, a vast remnant of the Nauplii pass into the Cypris stage. This transformation derives its name from the surface resemblance which the Cirripede undergoing it assumes to the genus *Cypris*, among the Ostracóda or Box-Crustacea, discussed in the last chapter. The soft parts and appendages of the organism are now almost entirely enclosed in a pair of valves comparable to those of a minute mussel, with the insignificant appearance of a little brown ovate seed. But if we look after the inward parts of them, we shall find them not at all like those of a mollusc. They are now approaching the character of the adult form. The animal will before long settle down in life, and form a permanent attachment. There is no romantic love-making concerned in this; the attachment in question is a local affixing. By means of cement-glands the head is attached to any suitable object, and the legs thrown upward, or, if not upward, at least in a direction opposite to the foothold which is monopolized by the head. There is no clownishness or dramatic vulgarity in this eccentric behaviour of the legs, since these many-jointed and beautifully plumose limbs (the cirri-peds or ringlet-feet) are encased within a variety of plates or valves, from which they only protrude when occasion demands, with coy reserve.



Cypris-stage of *Lepas australis*.* From Darwin.

In *Lepas*, and various other genera of the pedunculate or stalked barnacles, the valves are reduced to five, a manageable number for purposes of explanation. The narrow curved valve on the left, in the figure given above of an adult *Lepas anatifera*, is called the carina, or keel, from its shape. It is unpaired. At the top of the figure is seen one of a pair of valves called terga or back-plates, and below this on the right, one of a pair called scuta or shields. In *Scalpellum* there are from twelve to fifteen valves, and the peduncle is covered with scales. Nevertheless, the five primary valves above mentioned maintain a predominance. In the old genus *Pollicipes*, which was already flourishing in the Lower

* *Die Nauplien der Lepaden.* Carl Chun. *Bibliotheca Zoologica*, 1895.

† "On the Early Development of Cirripedia." By Theodore T. Groom, B.SC. *Phil. Trans. R. S.*, 1894.

* The specimen having been treated with caustic potash, and so rendered transparent.

Oolite, the valves range from eighteen to the rather bewildering number of over a hundred. On the other hand there are genera, such as *Dichelaspis*, in which the five plates, so far from requiring to be supplemented, themselves dwindle away to more or less feeble strips, and lead the way to groups which have no valves at all.

Scalpellum tritonis Hoek. From Hoek.

In the Balanidæ, or Acorn Barnacles, the peduncle, which in *Lepas* is sometimes more than a foot long, does not put in an appearance. Hence these are sometimes called sessile cirripedes, as being seated fairly and squarely on their bases, that is on their heads, without the intervention of a stalk. Sometimes, on the other hand, they are distinguished from the pedunculates as the operculate. The reason of this is that the shields and back-plates no longer form the main walls, but give place to a more or less cylindrical, shelly circumvallation, in compartments four to eight in number, often very firmly consolidated, and having a sort of roof, usually somewhat sunk in, compactly closing the summit. This roof, or operculum, is formed by the neatly fitting and movable scuta and terga. As in the pedunculate Thyrostraca, these valves can open or shut for the protrusion or shelter of the feathered limbs. When the living animals are placed in a bowl of sea-water, as soon as all seems to be safe and quiet, the valves will slowly open, and the plumes will be displayed. In one respect the Cirripede is like the vulgar criminal who, in response to his sentence, informs the worshipful magistrate that he can "do it on his head"; but the criminal is loose in an involuntary prison, while the Thyrostracan is fastened to a fortress of its own construction. From this it waves its arms for food, summoning any minute marine animals that happen to find life not worth living to come to its embrace.

Among the Cirripedes there can as a rule be no rivalry in love, no heartless desertions, no inequality of the sexes, because in almost all of the group both sexes are united in one body, and such interchange of affection as may, notwithstanding this, take place between different individuals, must in these fixed animals be determined much more by the accidents of proximity than by choice or inclination. But in the genera *Ibla* and *Scalpellum*, Darwin found that there were, besides the usual combined forms, some independent females. Upon each kind, in some instances, he observed curious little parasites, and proceeded to make the strange discovery that these seeming parasites were independent males of the species on which they were found. Those of them which he found attached to animals of double sex he named "complemental males." Anyone who wishes to pursue this difficult branch of investigation must not fail to study what the original discoverer has written upon it, and what has since been added by Dr. Hoek in 1884, and Dr. Aurivillius in 1894. In another branch of the subject, Dr. H. J. Hansen has marked the opening of the present year by giving reasons for cancelling that group or division of the Cirripedes which bore the uncouth name of the Abdominalia. Darwin himself gave eight years of steady work to the study of this great sub-class of the Crustacea. Alluding to the published results, in his autobiographical chapter, he says, "I do not doubt that Sir E. Lytton-Bulwer had me in his mind when he introduced in one of his novels a Professor Long, who had written two huge volumes on limpets." As to the complemental males, he says, "This latter discovery has at last been fully confirmed; though at one time a German writer was pleased to attribute the whole account to my fertile imagination." In the opinion of Dr. Hoek, and of most competent naturalists, Darwin's monographs, though with such errors as all foundation works contain, mark the dividing line between the dark ages and civilization in respect to the science of Cirripedes. One very anomalous form dates back even to the Wenlock limestone, so that they are not creatures of yesterday. But, though the group may thus claim to be coeval with the trilobites, instead of following the trilobitic example of passing into decay and extinction, it appears to have been continuously expanding. We may regard ourselves, with the vanity natural to man, as living in the era of Shakespere and Galileo, but from a geological point of view, we are rather, according to Darwin, living in the Age of Cirripedes.

CUSTOMS OF SHAKESPEARE'S GREENWOOD.

By George Morley.

[While correctly representing the existing customs of Shakespeare's greenwood, the subjoined examples are not confined exclusively to Warwickshire.]

THOUGH the influence of modern civilization has had a depreciating effect upon the customs of the country in certain places, the sequestered position of Shakespeare's greenwood has, in a great measure, rendered it impervious to the revolutions of change; and in many of the out-of-the-way hidden villages there may still be seen the quaint and often picturesque customs in which "the rude forefathers of the hamlet" were wont to take delight.

And not only in the immediate greenwood of Warwickshire are customs practised to-day which date so far back as to render their origin obscure, but in centres of the county which are now busy with the hum and bustle of industry, and the gathering place of toiling thousands, customs of quaintness and antiquity are still prosecuted with a vigour which at present shows no sign of abating, in spite of legal attempts to crush them.

One of these erstwhile village customs is that of the Shrove Tuesday festival of football which is played annually in the streets of Nuneaton—the "Milby" of George Eliot's "Scenes of Clerical Life"—and also at Atherstone. On the morning of the day the towns present quite a holiday appearance. The shops are closed and shuttered, and the young men turn out in hundreds to play their balls through the streets from one end of the town to the other, and win cheers and bright smiles from the faces of their bonnie lasses. In the observance of this custom Warwickshire enjoys an almost unique position, for there seems to be only one other place in England (the town of Dorking) where the practice is carried out.

The Shrove Tuesday festival is the first custom of the year in Warwickshire. The next custom is that of the mothering. It is the tie which binds the hearts of the family together, making every member of it one—in feelings, aspirations, thoughts, and sympathies akin; and bringing them all together at least once a year, after the manner of the rhyme used for the occasion.

"The lad and lass on Mothering Day
Hie home to their mother so dear;
'Tis a kiss for she and a kiss for they,
A chine of pork and a sprig of bay,
A song and dance—but never a tear."

The favourite joint for the mothering is a chine of pork, with the stuffing flavoured with a few leaves of the aromatic bay; and the after-dish consists of the famous fig pudding alluded to by Shakespeare. In many an isolated cottage the preparation of these well-known and ancient dishes for the table and the palates of the children returning home once more, is a labour of love and great ceremony to the homely cottage woman. Both married and single children observe the custom of the mothering, and the fourth Sunday in Lent is, indeed, a day of rejoicing under many a thatched roof in "leafy Warwickshire."

No more picturesque or mirth-moving custom could well be imagined than the Eastertide practice of "lifting," which used to be largely in vogue on the village greens of this neighbourhood, and was, until recently (and may be so even yet), still extant in some of the more secluded places. It may be that the so-called refining influences of modern civilization have been the means of causing this purely Arcadian custom to fall somewhat into disuse. In any case, what was an annual event looked forward to with pleasure at the beginning of the century, is, at the end of it, a custom "more honour'd in the breach than the observance"—a picturesque and merry scene being thus lost to English country life.

The custom in the villages of Warwickshire was to hold two "liftings"—one on Easter Monday and the other on the following day. On the first day of the junketing the rustic youths "lifted" the lasses—that is, took them up lengthwise in their arms and kissed them. All were served alike—the buxom, the slender, the comely, the plain, the saucy, the shy—so that there should be no complaining of more favour shown to one than to another. On the second day the girls returned the compliment and lifted the young men. There seems to have been even more merriment at the second performance of the custom than at the first.

Certainly one of the prettiest customs still in active practice in the shady lanes and on the village greens of Warwickshire is the Maying custom. The method is probably much the same in all the counties of rural England in which the festival is still observed; the only difference may be in the wording of the carols which are sung upon the occasion.

In Shakespeare's greenwood the general rule is to hold the festival upon the twelfth of the month—old May Day. The earlier hours of the previous day are occupied by the children in a perambulation of the parish, calling upon the farm folk and other residents for gifts of flowers and finery with which to decorate their maypoles. In the evening the large maypole is hoisted on the village green, or in some paddock or orchard lent for the purpose, and the election of the queen takes place. Some villages have a king and queen, but the majority elect a queen only.

On the morrow the queen and her attendants, as richly bedizened as flowers, ground ivy, may blossom, and patchwork can make them, again parade the bounds of the parish, singing their May songs (first at the doors of the squire and the parson, and then at the houses of the lesser people) round a portable maypole, finally returning to their ground or play mead, where the songs are sung over again.

After the songs dancing begins, and in some villages in the immediate vicinity of Shakespeare's birthplace the festival of the day is concluded in the rectory, where children of a larger growth keep up the dance with unflagging energy until the small hours of the next morning.

In the little border village of Welford (just below the "Hungry Grafton" and adjoining the "Drunken Bidford" of the well-known verse erroneously attributed to Shakespeare) there stands in the centre of a raised mound, encircled by a hedge, a maypole which is regarded as the successor to one around which Shakespeare himself must often have danced with his Shottery lass. The existing maypole stands seventy-five feet in height, and bears upon the shaft the faded colours of the red, white, and blue "ribbons" which it was the custom to paint upon the pole in the poet's days.

Shakespeare alludes to the practice of painting the maypole in "A Midsummer Night's Dream" (Act III., Scene 2), where Hermia thus addresses Helena—

> "And are you grown so high in his esteem
> Because I am so dwarfish and so low?
> How low am I, thou painted maypole?"

The ancient custom of ringing the curfew at eight o'clock every evening is still practised with unfailing regularity in many villages, and without which many of the rustics would not know the time for bed, for "there is no clock in the forest."

As there are customs that make for joy in lifetime in active use in this historic county, so there are customs of a pathetic and sympathetic nature observed at the close of a person's life.

For example, there is a well-established custom among the peasant folk of attending their village church on the Sunday morning following the interment of a relative, the female mourners remaining seated and deeply veiled during the singing of the hymns. This emulation of the custom observed at the singing of the *Dies Iræ* is strictly conformed to upon frequent occasions.

Among the dwellers in this poetic neighbourhood the custom of using sprigs of rosemary, both at weddings and burials, is still observed, much in the same way as mentioned in "Romeo and Juliet." Rosemary, indeed, is "for remembrance" in many ways. A maiden will give her lover a sprig when the time comes for them to part, and she will receive one from him. The shrub is largely grown in the cottage gardens, and from Shakespeare's days down to the present time it has played an important part in the floral and other customs of this county.

The festival of the ingathering or harvest home is not restricted to the occupants and workers of the farm, but is extended, by means of an outdoor demonstration, to all the dwellers in the village—so far, at least, as the first portion of the ceremony is concerned. A case I have in mind, which occurred at a village in the historic Vale of the Red Horse (the property of Lord Willoughby de Broke), no longer since than the autumn of 1892, may be regarded as typical of the manner in which it is now customary to observe the celebration in honour of a bountiful harvest.

On a beautifully fine October day, the celebrants met at four o'clock in the afternoon, at the sign of the Swan. There a procession was formed. Farmer Trab and Master Scoles were mounted on stout horses, representing the farmer of 1792 and 1892. Flags and banners with harvest mottoes; the village drum and fife band; serving-man carrying sheaves of wheat, barley and beans; a gay farm waggon (drawn by the farmer's dandiest team), laden with vegetables; a rustic bearing a huge loaf of bread upon a pole; a pony-carriage in which was seated the wife of "Farmer Trab," in quaint costume of the end of last century, attended by a cockaded flunkey; these and other items followed behind the farmers of two centuries.

Having gone a tour of the village the procession halted in front of the house of the lord of the manor, where Farmer Trab doled out bread and cheese to the farm servants from a basket in front of his saddle, and some

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wine from a wooden bottle slung at his side, much to the amusement of Lord and Lady Willoughby de Broke, who viewed the proceedings from the steps of the Manor. This done the company returned to the sign of the Swan, to feast at the generous table furnished by the host, and to perpetuate the harvest custom in "potations pottle deep" after the usage of Shakespeare's time.

There is, perhaps, no more curious custom extant in England than that known as "the Candle-light Auction" for the Warton grazing rights, which occurs in the month of October immediately subsequent to the commemoration of the harvest home.

Between the Warwickshire villages of Polesworth and Atherstone there is a small hamlet called Warton. At the sign of the Boot, or the Hatter's Arms of this village (the two inns which the village boasts) this quaint custom, dating from the time of George the Third, is annually celebrated. It relates to the letting of certain grazing rights upon the herbage growing at the roadside and upon the common lands in the parish. The rights are let by auction and the custom is that the whole of the grass has to be sold by candle-light, and the last bidder, when the flame burns out, is declared the purchaser.

The road surveyor of the day performs the duties of auctioneer, and is present with candle and book. The latter, doubtless, would be highly entertaining to the antiquary, inasmuch as it contains the records of these yearly auctions by candle-light from October 1st, 1815, to the present time, with the prices realized at each sale. At one time, soon after the institution of the custom, the sales used to realize about fifty pounds, but a quarter of that amount is now considered a satisfactory result.

All being ready, the tallow candle is cut into five lengths, half an inch high, there being five lots of herbage to be sold—each half inch of candle being for one lot. Then the road-surveyor auctioneer proceeds to describe the lots.

But the eyes of the company are, for the moment, attracted only by the flame of the candle. It is something to watch; something to make jests upon. The company show not the slightest disposition to bid for the herbage until the candle-light is dying out. Then the competition is remarkably brisk, and at the last flicker of flame each lot is knocked down by the road surveyor amid roars of laughter.

The custom of the payment of "wroth silver" to the stewards of the Dukes of Buccleuch, Lords of the Manor of Knightlow Hundreds, so far as is known is now practised in no other county of rural England. There was a similar custom in vogue in the New Forest in Hampshire in 1670, where "rother money" and "cattle money" appears to have been paid by the inhabitants to the owners of different manors for rights of herbage; but to-day, Shakespeare's greenwood seems to be the only place in England where this relic of early Saxon times is still practised with almost the same curious formalities as those observed at the wroth silver payment of eight centuries ago.

The custom dates from the days of King Canute (about the year 1018), who appointed a verderer or chief woodsman—represented by the land steward of to-day—over the forest districts, with powers to act as judge, and to see that no encroachments were made, or Royal Forest destroyed; to seize robbers frequenting the woods, to cause the destruction of wild animals, to see to the stalling of beasts of venery, and to prevent cattle straying.

The dwellers in the forests had certain privileges granted to them in regard to the grazing of the vast unenclosed lands, and these, in course of time, they obtained as their rights—often paying acknowledgments to the king, or to the lord of the manor, either in labour or remuneration, in money, or in cattle; and to these rights and charges are due the ceremonies of "wroth silver," "warth moneth," "hoctive moneth," "turf-dale moneth," and other similar customs, none of which now exist in Shakespeare's greenwood but that chief and most ancient of them all—"the payment of the wroth silver."

On Knightlow Hill (a slight eminence on the old London coach road between Coventry and Dunchurch, within the parish of Ryton-on-Dunsmore) the observance of this Saxon custom is annually carried out "before sunrise on Martinmas Day," the 11th of November.

The steward of the Duke of Buccleuch, woodlanders attracted by the prospect of rum and milk, representatives of the parishes upon which the toll is levied, and a few other persons (mostly antiquarians) interested in the practice of this curious ceremony of feudal times, assemble round the base of an old roadside cross which stands upon the brow of an ancient British tumulus or barrow, and in which there is a hollow formed for the reception of the wroth silver. Tolls ranging from one penny half-penny to two shillings and three half-pence are "called" from twenty-eight parishes in the Hundred of Knightlow; and for non-payment of these fees there is a fine of twenty shillings for every penny not forthcoming, or else the forfeiture of a white bull with a red nose, and ears of the same colour.

The ceremony in its chief points is as follows:—The steward, as the emblem of authority, takes his stand facing the east, and invites those present to form a ring round the broken cross, whereupon he recites "The Charter of Assembly," commencing "Wroth silver collected at Knightlow Cross by the Duke of Buccleuch, as Lord of the Manor of the Hundreds of Knightlow." The parishes liable to pay the fees are then cited to appear, each representative (on the calling of the name by the steward) casting the required sum into the hollow of the cross.

The ancient mode of payment was that the person paying must walk thrice round the stone and say, "the wroth silver," and then lay the money in the hole before good witness; for if not duly performed the parishes were in danger of the fine. These formalities have but slightly changed through the eight centuries of their observance, the custom of to-day being that the person does not walk thrice round the stone as in the original practice, but simply throws the money into the hollow of the stone, calling out "wroth silver" as each separate amount falls in, the money being afterwards gathered (in single payments) into the hand of the modern representative of the ancient verderer. Subsequently a breakfast is partaken of at the Shoulder of Mutton Inn at Stretton-on-Dunsmore, where the health of the Duke of Buccleuch, "the Lord of Knightlow Hundreds," is drunk in the time-honoured glasses of rum and milk.

Once only during the present century has the fine for non-payment of "the wroth silver" been exacted, and then the animal was rejected as not answering to the description prescribed by the charter—namely, "a white bull with a red nose, and ears of the same colour."

Microscopy.

By John H. Cooke, F.L.S., F.G.S.

Mr. Robertson, M.A., B.SC., of St. Andrew's University, finds that there are many plants which do not allow of the use of the filter pump for injection-staining or of treatment by the well-known method of Von Höhnel. For such specimens he suggests an alternative method, which he thinks will be found useful, both to private workers and for classes. A piece of india-rubber tubing, eight or more feet in length, is securely wired to the end of a large glass funnel. The apparatus is fixed at a con-

venient height, and a compressor clip is affixed to the free end of the tubing. A section of the stem to be injected is cut smooth and round, and is securely wired in the lower free end of the tube. A weak aqueous solution of fuschin is poured into the funnel, the compressor clip is removed, and a beaker is placed below to receive the drippings. After a few hours it will be found that much of the solution has passed through the conducting elements, staining them *en route*. The stem is then affixed to a second apparatus and treated in a similar manner with a weak solution of picric acid. This second treatment darkens the stained elements and fixes the tissue. If the specimen is intended for sectioning, it should finally be placed in ninety per cent. alcohol for a few days, after which it will be ready for the microtome.

The following method of making a culture cell whereby the various stages in the propagation of the diatomaceæ may be directly observed under the microscope is both simple and effective. It was first suggested by Dr. P. Miquel, and has since been used by him in his laboratory with considerable success. To a glass slip cement a glass ring out of the side of which a small piece has been cut. Cover this with a cover-glass. Through the orifice introduce the cultivating media containing a small quantity of a culture of, say, *Nityschia longissima*, and expose to the light. In the course of time the interior of the cover-glass will be covered with a beautiful growth of the frustules of the diatoms. This cell must, of course, be stood upright on its side. Cells may also be prepared by making the orifice in the cover-glass.

To clean cover-glasses and slides, immerse for one hour in a mixture made by adding to a saturated aqueous solution of potassium bichromate about one-eighth of its bulk of strong sulphuric acid. This will also be found useful for cleaning glasses that are intended for use as coloured screens.

Herr K. Koninski suggests a new gelatin-formalin method for fixing paraffin sections to the slide. The plate is first covered with a film of gelatin by the usual method, and, when this has set, the ribands of sections are arranged on it. The plate is then gently warmed until the gelatin has liquefied. Remove the superfluous gelatin with bibulous paper and allow the preparation to set. To render the gelatin firm and insoluble, the plates are immersed in pure formalin for ten minutes. Thus prepared, the mounts are sufficiently hard to resist the action of boiling water.

The following will be found to be a useful cement for making live-cells and zoophyte troughs, and for cementing the glass of aquaria. Dissolve gum elastic and thoroughly rub in with it a sufficiency of white lead and linseed oil varnish to form a paste.

The last number of the *Journal* of the Quekett Microscopical Society contains a *résumé* by F. Rousslet, on "Micro-Cements for Fluid Mounts." The author has obtained his best results by first giving a coat of pure damar in benzole, then a coat of a mixture of damar and gold-size, then three or four thin coats of pure gold-size at intervals of twenty-four hours, and finally a thin coat of Ward's brown cement.

The high refractive index of oil of cassin, and the fact that it dries hard enough to make permanent mounts, renders this reagent particularly useful to microscopists. It has an index of 1·6016, and clears from eighty per cent. alcohol.

To determine the character of a residue, place a small portion on a glass slip and saturate it with a drop of water. Note the general characters of the particles with the aid of a one-inch or a half-inch objective. At the end of the glass slip, place a drop of a ten per cent. solution of sulphuric acid, and at the opposite end a small piece of blotting paper. Diffusion will take place, and if any particles of carbonates be present, they will reveal themselves by effervescing. Quartz grains, clay, and carbonaceous matter will remain unaffected.

Coloured screens, for the purpose either of increasing the contrast between different coloured objects in a specimen, or of reducing it, are useful adjuncts to the equipment of the microscopist and the photo-micrographer. To obtain perfection of definition and of contrast either for visual or micro-photographic work, the use of partial monochromatic light is essential when working on bacteria and similar subjects; and the following plan for making reliable screens may, therefore, be of assistance to those who are engaged on this branch of study. It was first suggested by Mr. Wall to Dr. Spitta, the author of "Photo-micrography." Coat a patent plate with a two and a half per cent. solution of albumen; and, when dry, pour over it one hundred and seventy minims of an eight per cent. solution of gelatine, level and allow to dry. To make red, orange, green, or violet screens, soak the prepared plates in a one per cent. solution of crysoidine, aurantia, napthal green, and methyl violet respectively. For yellow screens, soak the plate in a solution of twenty grains of picric acid, dissolved to saturation in absolute alcohol, two ounces of water and a little ammonia.

Dr. Caspar O. Miller has developed an elaborate method of studying the mycetozoa by means of which he expects to ultimately obtain pure cultures. Bacteria are present in all cultures, and he is, therefore, now giving his attention to the influence that these have on the growth of mycetozoa. The plan of working that he most favours is as follows:—Well wash a handful of hay until the water is colourless, and then leave it to soak for about twenty-four hours. Pour off this water, filter it and dilute with fresh water until it is of a white wine colour, after which add two per cent. of milk to the infusion. Filter again and sterilize for future use. The hay is then cut up and placed in Erlenmeyer flasks, sufficient to fill them two-thirds full. Just cover the hay with water and sterilize for fifteen minutes, and repeat this process the following day with fresh water. This water is then poured off, and sufficient of the previously prepared infusion of hay and milk is added to cover it to a depth of one centimetre, after which the flasks are sterilized in a steam sterilizer for ten minutes on three successive days. They are then ready for use. The cultures were transplanted by means of a sterilized pipette. The results of the experiments were communicated to the *Journal of the Microscopical Society*, Vol. XLI., and all who are interested in the aseptic cultivation of mycetozoa would do well, therefore, to refer to that journal for he detailed description which it contains.

The following method for embedding small bodies, such as spores and pollen grains for sectioning in large quantities for class purposes, has been successfully adopted in the botanical laboratory of the University of Ohio. The spores are placed in a small test-tube and treated as for paraffin embedding. When the material is ready the tube is filled with paraffin, and after the spores have sunk to the bottom the whole is quickly cooled. The paraffin soon hardens. The tube is then broken, leaving the paraffin cast, which, with a little trimming, is at once ready for the microtome.

NOTES ON COMETS AND METEORS.

By W. F. Denning, F.R.A.S.

Present Comets.—The telescopic observer is now virtually without cometary objects, as Wolf's, Chase's, and other comets recently visible have become exceedingly faint, and may not be suitably observed unless in very powerful instruments. No discoveries of new comets have yet been effected this year. There are, however, several periodical comets near their perihelion passages, viz., Barnard's (1892 II.), Denning's (1881 V.), Tempel's (1866 I.), Tuttle's (1858 I.), and Holmes's (1892 III.). The three former are likely to elude observation owing to their unfavourable positions. It is particularly unfortunate that Tempel's comet of 1866 is situated at a disadvantage, as many observers would like to see the comet which is closely associated with the Leonid meteoric shower. But it can only be well seen on occasions when it reaches perihelion in about November or December, and if we assume that the comet has the same periodic time as its affiliated group of meteors, then this will happen only once in a century, and the object will not be seen again until the close of 1965 and opening of 1966, when it is likely to be presented under the best circumstances. Tuttle's comet was rediscovered by Wolf at Heidelberg on March 5th, when it was very faint, and estimated of the 11½ magnitude. It is moving to E.S.E. about 1° per day, and on April 1st will be placed in R.A. 44° 49′, Dec. + 24° 11′.

Holmes's Comet, which exhibited such a novel and rapidly changing aspect in the autumn of 1892, has a period of 2521·2 days according to Zwiers, and may be expected at perihelion (after allowing for perturbations by Jupiter and Saturn) on April 27th, 1899, but it will be invisible until later months, and will, at the best period, be placed at a considerable distance from the earth. Its conspicuous appearance in 1892 favours the view that it will be re-observed, notwithstanding the unfavourable conditions which will affect its visibility.

XUM

Tempel's Comet (1867 II.).—This comet was seen at its returns in 1873 and 1879, but escaped notice in 1885 and 1892. Gautier pointed out, some time ago, that under the powerful influence of Jupiter's attraction the time of revolution had been lengthened, and announced that a perihelion passage of the comet would occur in September, 1898. It evaded detection, however, though Perrine, at the Lick Observatory, made a careful search for it with the 36-inch refractor and other instruments.

Meteors of March 1–4.—Fireballs have often been observed to be unusually numerous at this period, and it is probable that a tolerably rich shower of slow bright meteors is occasionally, if not annually visible, though it appears to have previously escaped observation. From an investigation of the meteor-paths registered at Bristol, on the first few nights of March, the writer obtains radiants at 140°+51°, 166°+5°, 176°+9°, and 201°+67°, but the materials are not sufficiently numerous to indicate satisfactorily the positions of the best showers. A fine meteor equal to Venus was seen by Mr. G. T. Davis, of Reading, on March 1st, 1899, at about 8h. 45m., moving from 187½°+40½° to 205°+35° in 1½ secs. The same object was observed by Mr. T. H. Astbury, of Wallingford, traversing a path from 168°+33° to 191°+25° in 4 secs. A comparison of the two observations shows that the meteor passed over Essex, descending from a height of fifty-eight to twenty-two miles along a path of forty miles, with a velocity of about ten miles per second. The radiant point was at 119°+33°. Earlier on the same night, at 7h. 1m., Mr. Astbury had observed a meteor brighter than Sirius, falling from 340°+63° to 323°+44° in 2½ secs., clearly belonging to the same radiant in Gemini as that which furnished the large meteor at 8h. 45m.

The April Lyrids.—The Moon will reach her first quarter on April 17th at 10h. 43m., and will therefore greatly interfere with observations of this periodical shower in the present year. Something of the early part of it may, however, possibly be witnessed on the mornings of the 18th and 19th before sunrise. It will also be worth while looking for it on the night following, April 20th, for if the sky is very clear and the shower returns with unusual intensity, it may be well seen in spite of the presence of a gibbous moon. The shower is, however, often very feeble and always brief in its visible duration. There is one important point to settle in regard to its radiant at 270°+32°, and that is whether it exhibits an easterly motion similarly to the Perseids of August. There is very little doubt that the radiant varies in its position from night to night, but the thorough investigation of this feature must be relegated to one of the April periods when moonlight is absent and when several very clear nights occur successively.

The May Aquarids.—These should be looked for before sunrise, during the first week of that month. The radiant does not rise until about 1h. 45m. A.M., so that there is only a short time, in the morning twilight, available for observation. It is important that this shower should be well observed, as it has rarely been seen, and presents some orbital resemblance to the path of Halley's comet.

[*Addendum, March 15th.*—Since the above notes were written, Prof. Lewis Swift, of California, U.S.A., discovered a comet on March 4th, which he describes as just visible to the naked eye. The comet has been too far south and too near the sun to be favourably visible in England. At the beginning of April it will be about twenty degrees east of the sun, and will be placed to advantage in the mornings of May, when it will rise several hours before the sun.]

THE FACE OF THE SKY FOR APRIL.

By A. Fowler, F.R.A.S.

The Sun.—On the **1st** the Sun rises at 5.37, and sets at 6.31; on the **30th** he rises at 4.35, and sets at 7.19. He will be at his mean distance from the Earth on the **1st**. Sunspots have not been either conspicuous or numerous of late.

The Moon.—On the **3rd**, at 11.56 A.M., the Moon will enter her last quarter; she will be new on the **10th**, at 6.21 A.M.; will enter her first quarter on the **17th**, at 10.43 P.M.; and will be full on the **25th**, at 7.22 P.M.

The two most notable occultations of the present year will take place during this month. On the **15th**, μ Geminorum, magnitude 3·2, will be occulted. The star will disappear at 11.26 P.M., at an angle of 65° from the north point (26° from vertex), and will reappear at 12·8 at 319° from north point (283° from vertex). The Moon will be six days old, and the disappearance will take place at the dark limb. On the **28th** there will be an occultation of δ Ophiuchi, magnitude 3·4. The disappearance will take place at 11.56 P.M., at 89° from north point (114° from vertex), and the reappearance 1h. 6m. after midnight at 280° from north point (296° from vertex). The Moon will be nineteen days old, so that the disappearance will take place at the bright limb.

The Planets.—Mercury is too near the Sun for observation in this month. He will be in inferior conjunction on the **12th**, and will afterwards be a morning star.

Venus is a morning star, but is not well placed for observation. Her path lies very near the ecliptic through Aquarius and Pisces. On the **1st** she rises at 4.28 A.M., a little more than an hour before the Sun; on the **30th** at 3.37 A.M., about an hour before the Sun. At the middle of the month, three-quarters of the disc will be illuminated, and the apparent diameter will be 14·6″.

Mars is still well placed for observation, but his distance from the earth is rapidly increasing, and his apparent diameter diminishing. On the **1st** he crosses the meridian at 7.11 P.M., and sets at 3.30 A.M.; on the **30th** the meridian passage is at 6.4 P.M., and he sets at 2 A.M. The planet will be at aphelion on the **8th**, and in eastern quadrature on the **23rd**. During the month the semi-diameter of the planet diminishes from 8·4″ to 6·8″. The path of the planet is from Gemini, being almost in line with Castor and Pollux, at the beginning of the month, into Cancer, reaching a point not far from the Praesepe cluster about the end of the month. At the middle of the month nine-tenths of the disc will be illuminated.

Jupiter is very favourably situated for observation this month, being in opposition on the **25th**. On that date he will have a south declination of 12°, and an apparent polar diameter of 41·2″. During the month he describes a short westerly path in Libra, towards Spica Virginis. On the **1st** he will cross the meridian at 1.4 A.M., and on the **30th**, at 11.37 P.M., his altitude on the meridian being about 26°.

Saturn is not well placed for observation at convenient hours during this month. On the **1st** he rises about 12.50 A.M., crossing the meridian at 4.52 A.M., and on the **30th** at 10.52, crossing the meridian at 2.55 A.M. He will be stationary on the **2nd**, at a point in the most southerly part of Ophiuchus, and will afterwards traverse a short westerly path. His south declination is 22°, so that even when on the meridian his altitude in London will only be about 16°.

Uranus remains in the south-western part of Ophiuchus, not far south-west of the star ω. He rises shortly before midnight on the **1st**, and soon after 9.30 on the **30th**. The planet has a south declination of 21½ degrees, and will accordingly be very low in the sky.

Neptune may still be observed up to midnight in the early part of the month. He describes an easterly path, nearly a degree north of ζ Tauri, and preceding that star by an amount which diminishes from 5m. 12s. to 2m. 21s. during the month.

The Stars.—About 9 P.M. at the middle of the month, Leo will be on the meridian; Gemini in the south-west; Orion in the west; Virgo in the south-east; Hercules in the north-east; and Ursa Major almost overhead.

Algol may be conveniently observed at minimum on the **18th**, at 9.24 P.M.

Chess Column.

By C. D. Locock, B.A.

Communications for this column should be addressed to C. D. Locock, Netherfield, Camberley, and posted on or before the 10th of each month.

Solutions of March Problems.

No. 1.

(By V. H. M.)

1. R to B5, and mates next move.

No. 2.

(By W. I. M.)

1. B to Ksq, and mates next move.

[Several of our correspondents have attempted to solve No. 2 by 1. R to Q4, or 1. B to K7, overlooking Black's ingeniously provided defence 1 . . . P becomes a Knight.]

Correct Solutions of both problems received from Capt. Forde, G. G. Beazley, D. R. Fotheringham, Alpha, H. S. Brandreth, K. W., J. G. Parker, J. M. K. Lupton, W. Clugston, W. H. Stead, G. S. Hardy, F. V. Louis, one unsigned from Leeds, C. S. Kershaw.

Of No. 1 only, from Sunnyside, Miss Theakston, G. C. (Teddington), W. Hughes, W. de P. Crousaz, B. C. Tillett, H. B. Soper.

H. Bristow.—Revised problem will appear shortly. There is no harm in using a Black Queen to prevent a second solution, in default of a better way.

H. B. Soper.—R to R3 will not solve No. 2.

W. Hughes.—There is no dual in No. 1. Your definition of a "try" is correct, with the addition perhaps of the condition that the defence should not be immediately obvious.

A. Goldwater.—No. 1. If R to Kt4, B × B. No. 2. If R to Q4, P to Kt8, becoming a Knight.

G. A. Forde (Capt.).—Yes, there is a solution to the 3-mover which you send. The key is B to QB5.

E. Reed Makeham.—There is a solution. As the problem is rather remarkable, we print it below. You may perhaps like to try it again.

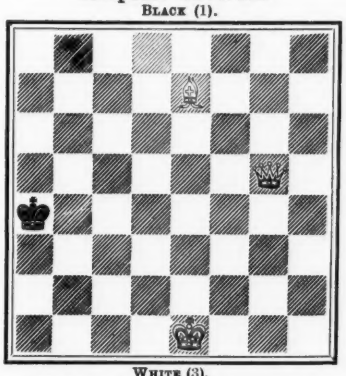
Several correspondents are thanked for their good wishes for the cable match.

PROBLEMS.

No. 1.

Composer unknown.

Black (1).



White (3).

White mates in three moves.

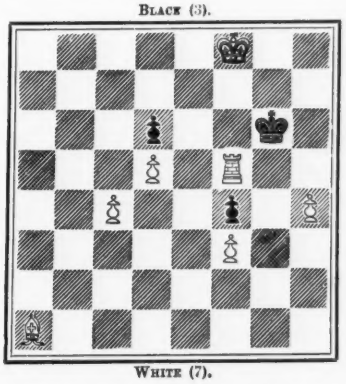
[This must be quite one of the best four-piece problems extant.]

No. 2.

By Jan Dobrusky.

(From the *Manchester Weekly Times.*)

Black (3).



White (7).

White mates in three moves.

[An ancient but always pleasing device.]

CHESS INTELLIGENCE.

Two club championships have recently been decided. At the British Chess Club Mr. Wainwright carried all before him. He won the handicap with a clean score of 11, and in the level tournament took first prize with a score of 8. The next in order were E. O. Jones, 6½; P. Hart-Dyke, 5; W. Ward-Higgs, 4½; E. Young, 4.

In the City of London Level Tournament the prize-winners were—

Section A.—T. F. Lawrence, 10½; F. Leye, 9; R. Loman, 9.

Section B.—Herbert Jacobs, 9½; L. Zangwill, 8½; P. Howell, 8.

Mr. Ward-Higgs tied with Mr. Howell for the third place in B, but lost in playing off the tie. In the final pool between the six prize-winners, Mr. Jacobs came out first with a score of 3½ out of 5, Mr. Lawrence failing to rise to the occasion. These short final contests are scarcely a fair test: in the final pool each competitor should play two games with every other.

The Anglo-American Cable Match took place on March 10th and 11th, the British team playing at the Hotel Cecil. Mr. Burn declined to play, his place being taken by Mr. Trenchard. The British team was evidently weaker than last year, while the Americans were evidently stronger than usual if they could afford to put Mr. D. G. Baird at No. 10. The victory for the United States by six games to four was accordingly not unexpected, though as the games went the English players should nearly have saved the match.

It is noteworthy that no less than seven out of the ten games were Ruy Lopez openings, and that the four English players of that opening were unanimous in castling on the fourth move. The score is subjoined, with a brief account of the games.

America.		Great Britain.	
1. H. N. Pillsbury	0	J. H. Blackburne	1
2. J. W. Showalter	1	H. E. Atkins	0
3. J. H. Barry	1	T. F. Lawrence	0
4. A. B. Hodges	1	E. M. Jackson	0
5. E. Hymes	½	D. Y. Mills	½
6. H. C. Voight	½	Herbert Jacobs	½
7. S. P. Johnston	½	C. D. Locock	½
8. F. J. Marshall	½	G. E. Wainwright	½
9. C. J. Newman	½	G. E. H. Bellingham	½
10. D. G. Baird	½	H. W. Trenchard	½
Total	6	Total	4

Board No. 1.—Mr. Blackburne, after converting his opponent's Two Knights' Defence into a Guioco Piano, took advantage of the open KB file presented to him, and obtained a slight advantage in position, in spite of an apparently useless manœuvre with his Queen. After the exchange of Rooks, Mr. Pillsbury, by a weak advance in the centre, allowed his opponent to establish a Knight at KB5, afterwards losing a clear Pawn by exchanging Queens. Mr. Blackburne does not appear to have selected the quickest way of winning, and Mr. Pillsbury, defending himself with great tenacity, was enabled to prolong the game and almost to save it.

Board No. 2.—Mr. Atkins selected an unfavourable defence to the Ruy Lopez, and Mr. Showalter found himself with two passed Pawns in the centre. Mr. Atkins might have pressed forward on the Queen's side, but confined himself too strictly to defensive manœuvres, and had to resign on the forty-fifth move. This is Mr. Showalter's fourth consecutive victory in these matches.

Board No. 3.—Mr. Lawrence played a variation of the Lopez at one time favoured by Steinitz, and more recently by Janowski. He lost a move with his Queen, and soon found himself with a defensive end-game, his opponent having two Bishops against Bishop and Knight. In the end he fell into a neat trap, the offer of a Pawn, and the Black King promptly marched in to QKt7, winning the QRP and the game. This is Mr. Barry's fourth consecutive victory.

Board No. 4.—Mr. Jackson defended the Lopez with the now discredited King's Fianchetto. He emerged, nevertheless, with two Bishops against Bishop and Knight, and a nearly even game. Mr. Hodges pressed the attack in the centre, and a Rook and Pawn ending in which Mr. Jackson wasted a move, resulted eventually in favour of his opponent.

Board No 5.—Mr. Mills played a weak move in the Lopez in order to avoid the exchange of Queens, but ingeniously forced the exchange of Rooks, and was left with Bishop and Knight against two Bishops. Mr. Hymes manœuvred his Bishops with superb confidence in apparently dangerous positions, and sacrificed a Pawn in order to Queen a Rook's Pawn. Mr. Mills, by an ingenious resource, obtained a passed Pawn in the centre, but overlooked a win, and though he eventually won a piece, this proved to be insufficient, and he had to be content with a draw.

Board No. 6.—Mr. Jacobs obtained a bad game through playing the centre Counter Gambit. His opponent unnecessarily gave up one of his Bishops for a Knight, and after an uphill struggle with Rooks and Pawns, Mr. Jacobs eventually obtained equality.

Board No. 7.—Mr. Locock took advantage of his opponent's defence to the Lopez, and obtained a strong attack which led to the win of a Pawn. He unnecessarily gave his opponent an opportunity for counter attack, and in trying to avoid a drawish position, obtained instead a difficult one. Eventually he found a difficult mode of saving the game instead of a simpler way of winning it. This was the first game finished.

Board No. 8.—Mr. Wainwright, defending the "stonewall" attack, overlooked a manœuvre which let his opponent's Bishops right into his game. Becoming eventually tired of the Bishops, he gave up his Queen, remaining with Rook and Knight against Queen and two passed Pawns. His opponent's neglect of one simple precautionary move allowed Mr. Wainwright to win the Queen's side Pawns with his Rook. After this the draw was easy.

Board No. 9.—Mr. Bellingham, playing the same variation as Mr. Mills, exchanged Queens and continued correctly with the Queen's Fianchetto. His opponent spent all his time in trying to preserve his two Bishops, and Mr. Bellingham obtained an attack which resulted in the gain of a Pawn. He remained, however, with Bishops of opposite colours, and overlooked his opponent's scheme for forcing the draw.

Board No. 10.—Mr. Trenchard defended the Lopez with his favourite P to KB4, and succeeded in isolating a Pawn. The players were left with two Rooks and a Bishop each, and eventually with Bishops and Pawns only. Mr. Trenchard tried hard for a win, but his opponent's King arrived just in time to stop the last Pawn.

KNOWLEDGE, PUBLISHED MONTHLY.

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